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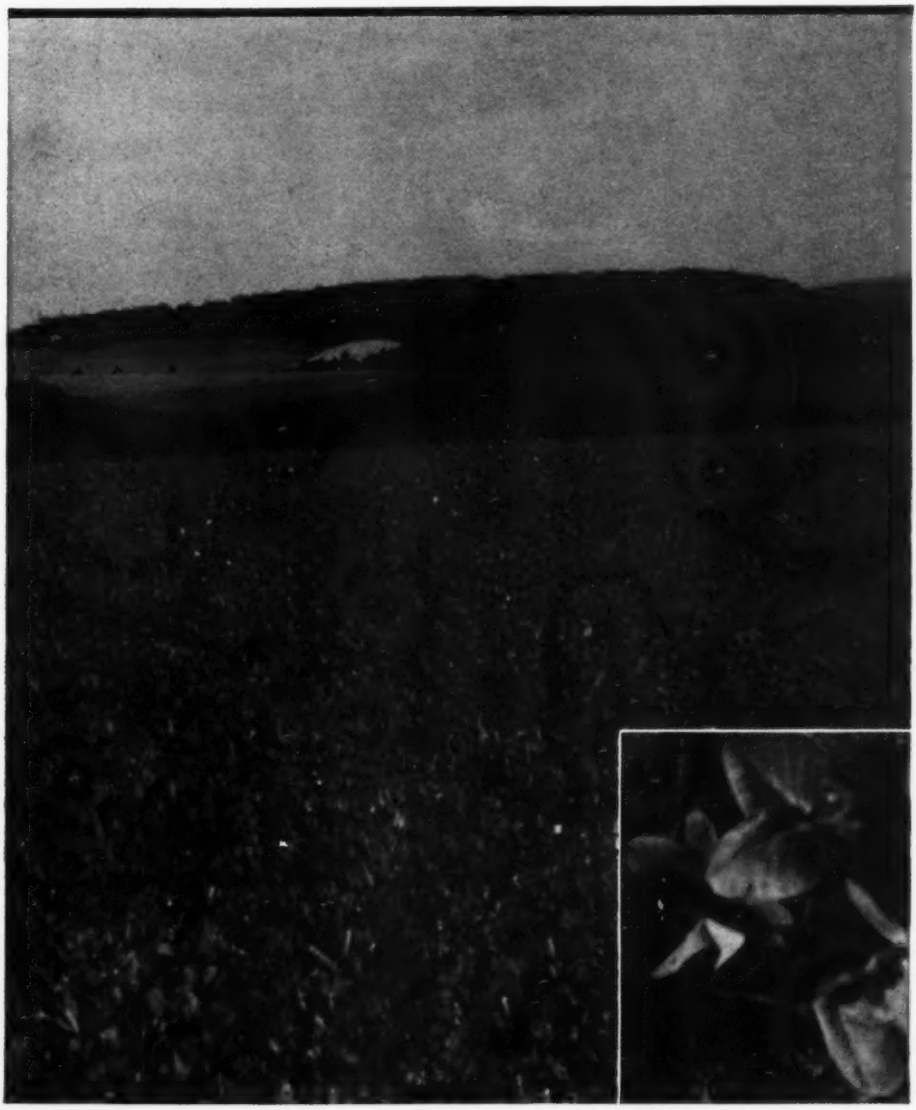

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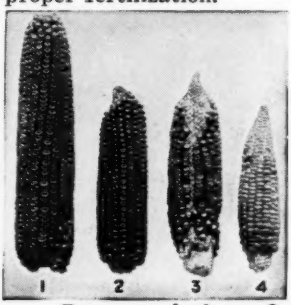

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VOLUME XXXVII NO. 1

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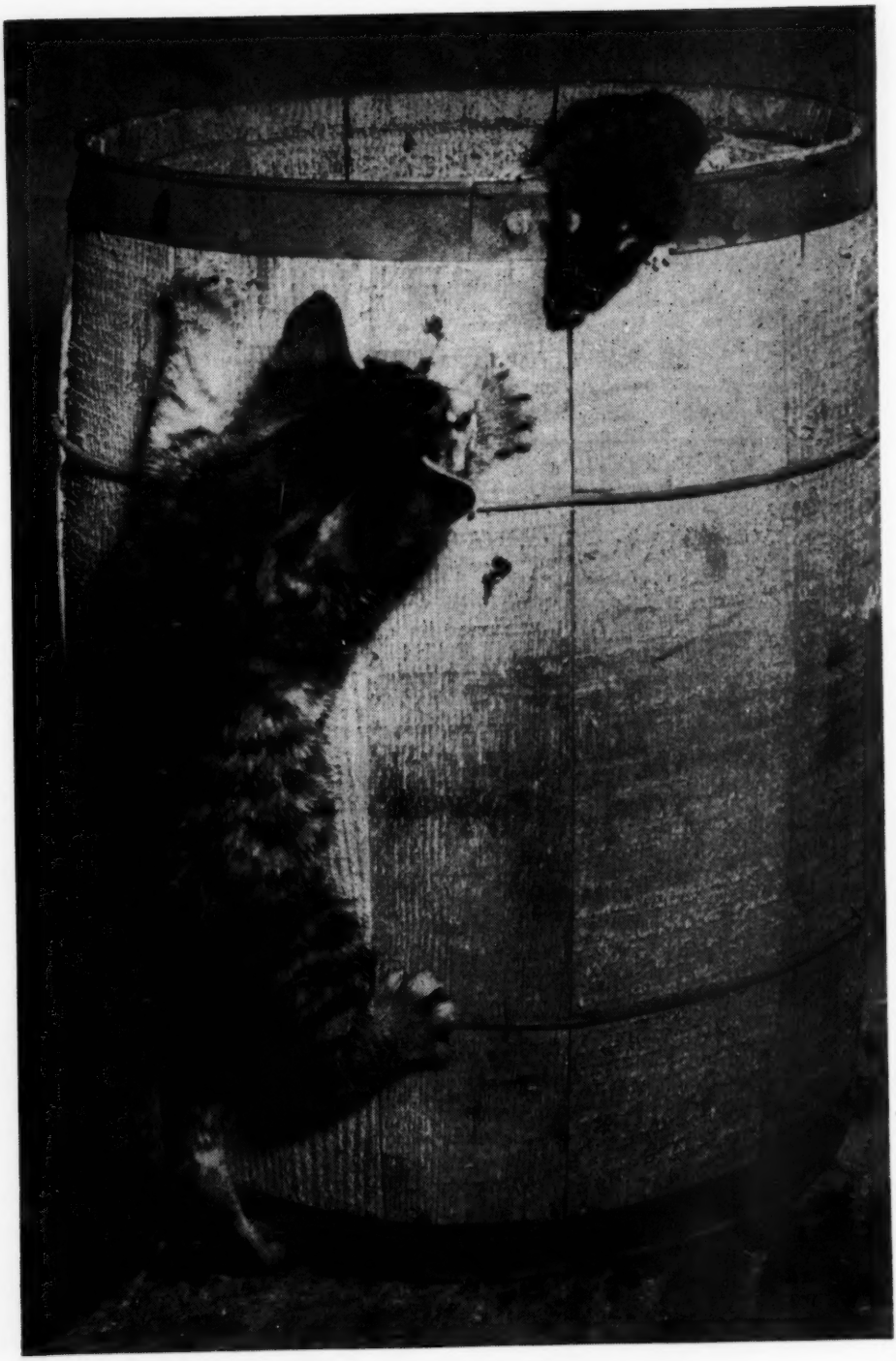

A Crucial Moment

Better Crops with PLANT FOOD

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Vol. XXXVII WASHINGTON, D. C., JANUARY 1953 No. 1

A look at . . .

Farm Budget Bothers

Jeff McDermid

THAT old traditional "ladder" whereby the youngsters of other times in theory could advance upward rung by rung, from hired man to farm tenant and then to part and full ownership by dint of thrift and good management, is a broken reed and a myth. How to finance young farmers is probably one of the gravest questions facing our generation. Money to "make the mare go" in the days of oats and harness has become mere chicken feed against the expensive equipment now required to plow and harvest.

You have doubtless seen those startling figures that compared the investments and operating charges on a score of New York State general farms today with the situation that existed during World War I. There are other reports just as disquieting and challenging. The values and financial investments for good farms have been mounting since 1940. Official estimates based on actual farm-management studies make one wonder just how huge the capital structure will get for the younger operators to swing through their own courage and capital risks. Most surely these figures tell us flatly that the days are gone forever when the member of the family who had the least grit and gumption was assigned to take over the inherited acreage—leaving the city's big business opportunities for the children with the shrewdness and ambition.

A typical farm growing feed crops, hogs, and beef cattle in the Midwest could have been bought for $20,500 about 12 years ago, including the livestock, equipment, and machinery. But a year ago the going value of this same type of farm stood at slightly under $70,000. Up in the Northeast a typical

dairy farm that cost only about $10,000 fully equipped in 1940 took $25,000 to buy in 1951. Down along the Piedmont in the cotton area a farm that cost $5,000 in 1940 called for an investment of $13,000 in 1951—and so it goes, almost every section showing similar advances in the "extension ladder" needed to reach the pinnacle of ownership.

No doubt young farmers are not the only rural youth who grapple with the enormous budget it takes to acquire a farm. The businesses that cater to farm needs and supply, repair, and service farm equipment have risen also in relative values. Prosperity and the high standards of living move in two directions it seems—toward a fuller and a more abundant life on the one hand and toward steeper capital needs and risks and more shrewd sense and technical skills on the other.

IN other words, we never get great benefits and advantages without complementary hazards and stiffer standards to meet. The attractive wench we call "good times" and yearn to embrace too often winds up with some earmarks of a nagging shrew. And the particular party in government power has relatively little to do with the case—as long as inflation roosts on our rooftree. Whether it's the money policy of the government or the money madness of the public that keeps the financial gas bag full is another good winter topic for farm forums.

In all this quandary that sends good farmers in perplexity to consult farm-management experts, there is at least the present comforting thought that farming is a business without which most other enterprises except those of the doctor and the undertaker would perish. Some way must be found, therefore, to sustain this keystone vocation of our national life so that the forthcoming generations of rural youth may be financed for production. The glad hands and applause and prizes bestowed upon the 4-H members and the Future Farmers in their brief hours of triumph must not be a mockery when the time comes for them to settle down to notes and chattels and amortized mortgages. It's too often been true that we had inspiring youth cheer leaders for all the "sporting events" on the rural calendar, but when it came to serious advice on getting credit and suitable terms for homes of their own, the enthusiasm petered out. Perhaps that's why we now see a lot more attention being paid to older farm youth in the early stages of married life.

In former times the fellow with small brains and good muscles and a liking for agriculture had as much chance to succeed in the furrow as the lad today who has good college training, good health, and farming experience. Obviously the reason was that old-time farm operating tools were few and simple, a large part of the job was for family sustenance alone, and the tremendous new world of science and commercial competition had not hit the hinterlands of somnolence and easy-going ways. We have looked backward to those quiet times with natural nostaglia—and learned a lot thereby betimes—yet nothing will be accomplished for a safe track ahead by looking out the rear door of the caboose. The job facing us now is to equip a skillful advance track-scanning crew to render wrecks less necessary.

THERE has been a continued trend toward fewer and larger farm units. Alongside it has come much greater capital invested per farm worker because of the consumer demand and the better equipment on farms. The high level of farm prices maintained both by the law of supply and demand and the artificial action of government is another factor. Many farmers who got hold of farms they now own in the early postwar years are now getting old and want to quit. But they are heavily capitalized with equipment and other non-real-estate assets, which must be acquired and allowed for in transfers to younger men. These younger chaps in their own turn will expand their in-

vestments in other gadgets and improvements, and the land values will probably rise also. The debt-free burden will be getting heavier instead of lighter, and with it the increasing need for the ablest and keenest sort of farm management.

It's only the most brilliant and ablest "Star" farmers and 4-H winners who bring any great accumulated original capital to the buying of a farm. Typically the beginning farmer has only his

devotion to agriculture, his earnest applied training, and a willingness to work hard. For this he seeks financial credit geared to his future needs. This is the place where the rural bank or other credit institution has to "go into a huddle" lest the signals be misunderstood.

Shall the tyro in tillage be granted a loan for the full purchase price of the farm's resources and equipment? Few there are who are very eager to take this leap into an unknown financial abyss—as both the lender and the borrower would be in a state of jitters while this thing lasted. Hence most beginners could not finance the outright purchase of a full-blown going farm. Neither could they adopt the old way of starting as a hired man with hopeful eyes to final ownership. Of course farm wages are more than treble what they were some years ago, but the saving of them is just as hard to accomplish now. Moreover, to rely upon possible inheritance of a going farm is often a long-time proposition which may not come true at a time when the youngster is ready to make his start.

Fortunately there are some young men who have grown up in a good farming community and are accepted as tiptop moral risks in any reasonable purchase deal. Sometimes they can arrange to borrow some pieces of equipment and have notes endorsed readily for the rest. To swing a real-estate deal comes hard enough but not so tough for these lads as for the majority who come into the game barehanded. Another limited number of competent and ambitious youth, many of them veterans, secured loans on easy terms from the Farmers Home Administration in cases where no other avenue of credit could be found. Here and there a few religious groups and other societies extend help in critical times for young borrowers who want to get farms.

BUT another dilemma bobs up too often. That's the difficulty of getting a line on any suitable farms. Young beginners must have land enough to make farming profitable, as well as the kind of land that won't require a heavy expenditure at once for fertility and conservation measures. Farms of large size, with considerable cultivated land as well as buildings and meadows to maintain properly, may also be far beyond the scope of the new recruit to handle.

Purchase agreements that can be fixed up between tired or retired farm-owners on good land and a worthy young partner are becoming more popular as one other way to break the deadlock. The young man goes to this neighboring landowner with little but his own eagerness and skill to recommend him. Perhaps the owner has no boys himself to look to for transfer of his property. So he agrees to dicker with the daring of his new-found friend.

They agree on a base wage to begin with, a sum that seems fair to both as an assurance of good faith. What it figures to annually is their own business, depending on the type of farm and the ability of the youngster. Besides the basic wage the farm-owner is willing to

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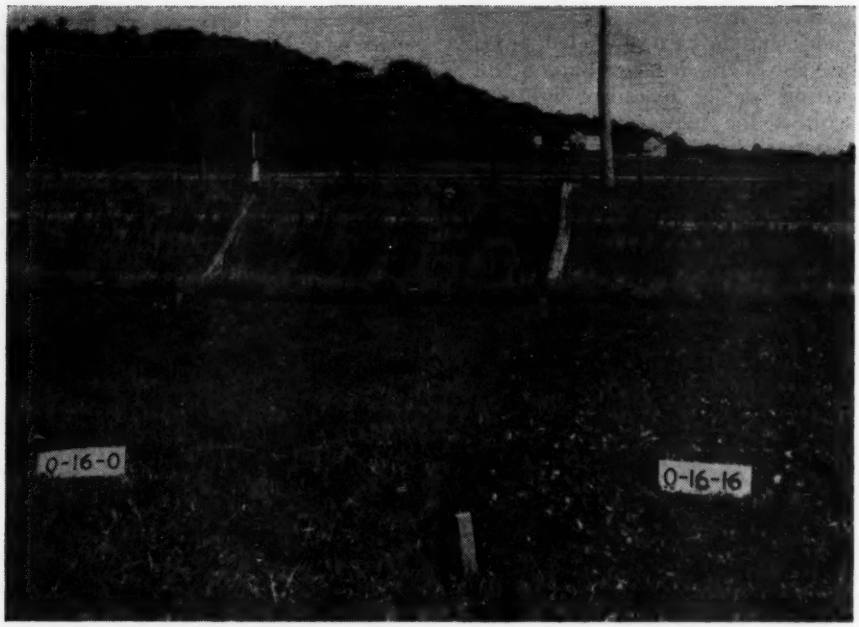

Fig. 1. Showing the poor percentage of ladino clover on the 0-16-0 plot compared to the 0-16-16 sward. This series is that of Demers (St. Nicolas) and it has been fertilized with a 500-lb. application of the respective treatments in both 1950 and 1951.

Phosphate and Potash Effects on Ladino Clover Swards

By L. J. Boulet[1] and Lucien Choinière,[2] Quebec, Canada

TALL-GROWING perennial legumes play a great part in modern grassland farming. With the introduction of ladino clover on a rapidly increasing number of Quebec farms, and the general success met with this legume, in many districts of the Province, our dairy farming should mark a good step in the near future.

Alfalfa was introduced in the Province some 40 years ago, but its progress has been rather slow, covering at present only a little over 2% of the total area of our hay crops. Red clover, a short-lived legume, with timothy still forms the bulk of our hay production, with the result that our hay crops are short of legume content. But with the rapid expansion of the perennial ladino

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clover, there are new and promising possibilities for hay and silage as well as for our pasture crops.

With these greater resources of tall-growing perennial legumes, an endeavor to prolong the duration of our hay fields and pasture leys at a high yield of quality production is taking place. This effort is concentrating on a proper management and a systematic use of topdressing as well as "seeding-time" fertilizers. If this objective is to be fully attained, one must realize the nutrient requirements of these tall-growing perennial legumes and adapt the fertilization practices to these requirements and the nature of our soils. Considerable work has been done on this subject, of which a review of literature is made herein.

During the last 25 years, many fertilizer trials including rates of phosphorus, potassium, and lime have been conducted in the Province to improve our permanent swards by surface fertilization. This improvement was characterized and often measured by the abundance of wild white clover. These tests were more or less a study of the nutrient requirements of wild white clover and of the mineral deficiencies of our soils for this crop. We have found that for the satisfactory growth of this low-growing clover, phosphorus fertilizer was generally beneficial, also potassium and lime on light soils.

But in the field of hay production and rotation pastures comparatively fewer fertilizer tests have been made up to date to study the specific nutrient requirements of our tall-growing forage legumes and the mineral deficiencies of our soils so that these legume hay crops could be maintained at high yields and quality for longer periods of time. A few fertilizer experiments conducted on rotation hay fields at the Central Experimental Farm (Ottawa), at Macdonald College, and at Lennoxville and Ste-Anne-de-la-Pocatiere Stations have given interesting results. If, however, one summarizes all these results and those obtained in the United States on the same subject, a need for further studies on this matter is felt for Eastern Canada.

Two years ago, at Laval University, Quebec, a revised experimental project was started to study the mineral deficiencies (phosphorus and potassium) of our soils for the satisfactory growth and maintenance of ladino clover swards.

It may appear premature to publish our preliminary results at this time, but considering the very rapid extension of ladino clover in Quebec and the striking results of some of our trials on ladino fertilization, we feel justified in publishing this article now. To give a little idea of this revolutionary expansion of ladino in this Province, one seed firm situated in the Quebec City region has sold alone in 1951, 10,000 pounds of ladino seeds, while its sales in 1950 were 6,000 pounds; in 1949, 4,000 pounds; and in 1948, only 200 pounds.

In this experimental fertilizer project, we have two main objectives:

1) The effects of rates of phosphorus and potassium fertilization on ladino clover swards sown on different soils;

2) The relation between yield and quality of ladino swards with levels of available phosphorus and potassium in the soils.

This preliminary report deals mainly with the first objective.

Review of Literature

Quite a lot of literature has been published in the United States on this matter. We shall review some of it before summarizing results obtained in Quebec and Ottawa experiments on the fertilization of tall-growing legumes.

Tall-growing legumes are heavy feeders on K and P.

"Ladino clover has a higher nutrient requirement for maximum yield than wild white clover, probably because of its much greater potential yield" (Hollowell, 1951). "It seems to need plenty of phosphoric acid and potash in the soil, and lack of them may be responsible for some cases of early disappear-

ance" (Dickey, 1946). "Fertility seems to be the key to successful ladino clover pastures" (Lovvorn and Dolson, 1948). It is very similar to alfalfa and red clover in its requirements for phosphate and potash. All these are heavy feeders on these two nutrients (1, 2, 5, 14, 20, 21, 24, 25).

Remarkable response from K.

Outstanding responses to liberal application of potash fertilizer have been obtained with ladino clover, alfalfa, or red clover stands by various research workers. Here are a few quotations on this particular point: "Much better stands and larger yields (of ladino) were maintained where generous amounts of potash were applied" (Brown and Munsell, 1941). "Chemical analysis, both of the soils and of the ladino grown on them (from 23 widely distributed farms in New Jersey) indicated that insufficient K was generally the reason for poor stands" (Stewart and Bear, 1951). "Potash is the fertilizer most likely to be deficient on ladino fields and remarkable response to liberal applications may be expected" (Brown, 1950). ". . . there is some evidence to show that increasing the level of potash increases the volunteering and persistence of (red) clover . . ." (Prince et al, 1947). "Our studies have led us to believe that the life-span of this plant (alfalfa) is frequently determined by the dosage of potassium applied in preparation for seeding . . ." (Bear, 1945).

Frequency of K and P applications.

The frequency of fertilizer applications, particularly of the potash element, also appears to be important for these tall-growing perennial legumes. According to Tysdal and Westover (1949), "alfalfa that is properly fertilized at seeding will not require topdressing the first year. Thereafter, however, it should be topdressed annually with applications of phosphate and potash, depending upon the requirements of the particular soil. In some cases, an annual application of 400-500 pounds per acre of 0-9-27 is required. In some cases, more phosphoric acid and less potash can be used." Bear (1945) states that "once the alfalfa plant gets well under way, it then becomes highly important to give it regular and generous doses of potassium every year, to prevent the soil's supply of this element from being exhausted to the point where its lack limits growth. Here again our experience indicates a need to apply between 500-1,000 pounds of an 0-12-12 fertilizer or its equivalent as a topdressing every year" . . . preferably after the first cutting. Tysdal (1951) reported that "alfalfa also does best when phosphate and potash are readily available. In some eastern states as much as 600-1,000 pounds of 0-10-10 are applied per acre before seeding followed by an application of 200-400 pounds as topdressing each year or every other year thereafter."

According to Donaldson (1940) "annual topdressing with fertilizer is important to keep ladino stands productive." Brown (1950) has found that "in contrast to limestone and superphosphate, enough of which can be added to last for several years, potash (or stable manure) should be applied (to ladino stands) at least once every year. This necessity for more frequent addition of potash than lime and superphosphate arises from the fact that plants absorb more potash than they need as long as it is available in the soil. Thus, with heavy infrequent applications the first crops get too much and subsequent ones too little potash. . . . The experimental evidence indicates that 200 pounds of muriate of potash (60% K_2O) or 12 tons of stable manure every year will maintain good stands and yields of ladino. Time of application is not very important."

Stewart and Bear (1951) concluded from a recent experiment that because of its shallow root system, ladino needs

Fig. 2. Some of the plots on Guenette's farm which have been fertilized with a 500-lb. application of the respective treatments in both 1950 and 1951. Some idea of the clover percentages under the different treatments can be readily obtained.

a readily available supply of K in the plow depth of soil. In light soils, heavy initial applications are likely to become leached beyond the reach of the ladino roots. At the end of three years ladino plots that had received annual topdressing, the equivalent of 60 pounds K_2O an acre, yielded 14% more hay than other plots to which a single application of 300 pounds of K_2O an acre had been made at seeding time. The 100-pound an acre application of P_2O_5 made prior to the first seeding of the ladino supplied sufficient P for the 4-year period of hay production on this soil. The evidence on topdressing ladino when grown for hay or silage as in this study indicates the desirability of using fertilizer grades with considerably higher percentages of K_2O than P_2O_5. And Prince and his co-workers (1947) found that annual application of potash encourages (red and alsike) clovers remarkably.

Decline in soil fertility.

Jones (1947) stated that the "early disappearance of those perennial legumes is often due to a decline in the fertility of the soil and the subsoil. Many farmers complain that where alfalfa is seeded on old alfalfa land after a prolonged period of production, the performance or response with fertilizers as used in the previous crop has not been like it was with the first crop. It seems reasonable to think that the soil, particularly the subsoil, has been somewhat exhausted by the previous crop." According to Prince and his co-workers (1947), as the fertility declines, timothy and clovers disappear and their place in the sward is taken over by redtop and other bent grasses, . . . and poverty grass, plants which can survive at lower levels of fertility than those which were seeded.

Nitrogen fertilization and nutrient competition.

Ripley (1948) reported that "minerals without nitrogen gave the highest yield of alfalfa on all soil types studied. Nitrogen depressed the yield of alfalfa below that of minerals on all soil types and below the check on the three heaviest soils where only nitrogen and potash were used." Prince et al. (1947) stated that "a uniform annual application of nitrogen was found to have a deterrent effect on clovers. Some evidence also points to the fact that the effect of nitrogen, either from complete fertilizers or manure, counteracts the favorable effects of potash on the amount of clover in the stand. . . . Contrary to legumes, nitrogen is the chief stimulating element to grass. Of course, if available phosphoric acid or potash is deficient in the soil, a response is secured from applying a fertilizer carrying one or both of these elements depending upon which one is deficient. In a topdressing experiment in which timothy was seeded without clover, nitrogen exerted the greatest positive influence on yield, although better germination of seed was obtained on plots which had received superphosphate prior to seeding."

Blaser et al. (1950) state that "nutrient competition among species may also be of help in explaining the degeneration of pasture and meadow mixtures from desirable to undesirable species. . . . This succession is commonly associated with depletion of fertility and with mismanagement. The rapidity of plant succession from desirable to undesirable species is probably enhanced by competition for nutrients among the species. Evidence for this is indicated by the relative intake of potassium by different species, i.e., weeds absorbing more than grasses and grasses more than legumes. . . . Nitrogen fertilizers increased the growth of grasses and decreased growth of the leguminous plants in a mixed association. As the growth of grasses was increased by nitrogen fertilization, the amount of potassium removed by the grasses was increased. Hence the concurrent and/or after effect of nitrogen on reducing the leguminous associate was attributed to competition for potassium . . . It should be stressed that competition for potassium is quite likely a factor in maintaining legumes only when the available soil potassium is low . . . The cycle of good and poor clover which is frequently observed in the Northeast may be attributed in part to this nutrient competition."

Stewart and Bear (1951) found that "applications of N had little effect on pure stands of ladino, but they greatly stimulated the orchard grass. Yields of orchard grass were increased 40% by the N when the grass was grown in a mixture with ladino and 44% when it was grown alone. The ratio of ladino to orchard grass was readily controlled by regulating the amounts of N and K that were used for topdressing. When no N was used the percentage of ladino in the mixture, on a dry-weight basis, was much higher than when N was applied. Reduction in dry weight yields of ladino in mixtures fertilized with N results from the competition of the grass for K."

From a greenhouse test conducted at Ottawa, Ripley and his co-workers (1951) found that "nitrogen itself has a slight depressing effect on the alfalfa but the oats by direct competition for nutrients or moisture have an even greater detrimental effect."

Fertilizer recommendations.

Those relatively recent findings about the nutrient requirement of these tall-growing legumes have more or less all been taken into account in the fertilizer recommendations of some border states of Quebec, i.e., New York (8), Vermont (27), New Hampshire (15). If we compare their respective recommendations for the topdressing of alfalfa or ladino swards, or swards containing over 50% legumes, New York recommends, if without manure, the

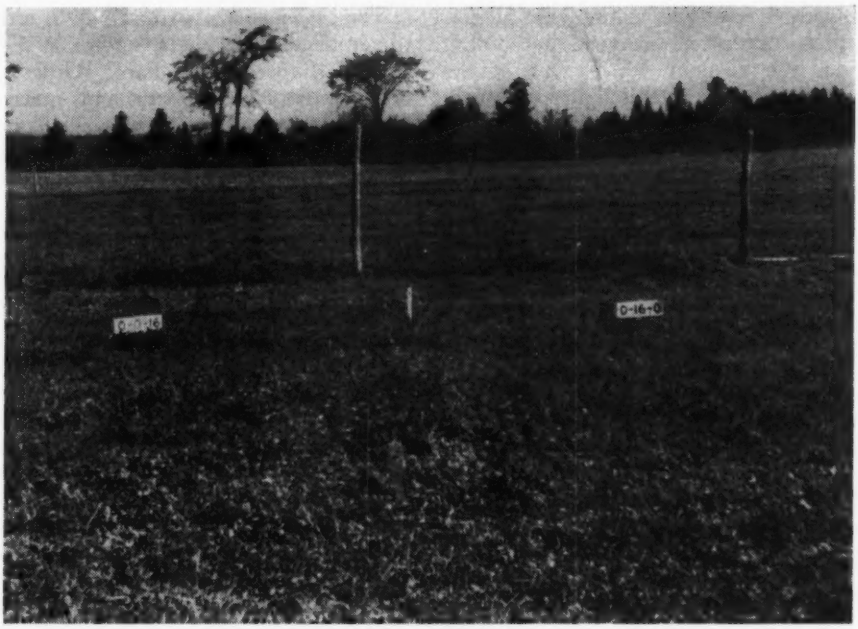

Fig. 3. From the Guenette series—a comparison of the two treatments, potash alone and phosphate alone.

equivalent of 120 pounds of P_2O_5 for a 4-yr. period on heavy soils and 150 pounds annually of 0-20-20 fertilizer on light soils or other soils known to respond to potash. For soils in a low state of fertility where stable manure cannot be used, it is recommended that fertilizer applications for individual crops be increased 25% to 50% over the amounts suggested. Vermont and New Hampshire indulge in more generous applications, recommending respectively 120 and 100 pounds of both P_2O_5 and K_2O annually.

Robinson and Garber (1949), summarizing and discussing results from fertilizer experiments on pastures and meadows in the northeastern United States, state: "The initial rates of phosphate fertilization generally recommended for depleted grasslands in the region range from 120-160 pounds of P_2O_5 per acre. Thereafter from 30 to 50 pounds of P_2O_5 per acre per year or two to three times this rate every second or third year are recommended. In general, the higher rates are suggested for the higher-producing pastures and meadows such as those containing ladino clover or alfalfa. In contrast to phosphate, potash should not be applied in heavy application at infrequent intervals. High-producing grasslands require about 100 pounds of potash per acre per year."

In Quebec not enough experimental results were found available to command similar recommendations, i.e., regarding frequency of application and fertilizer grades although some of our farmers growing ladino clover follow more or less the fertilizer practices as seen on farms of the border states. A summary of results obtained in Quebec and at Ottawa follows.

Review of results from Quebec and Ottawa stations.

Ste-Marie et al. (1950) at the Lennoxville Experiment Station, working with a 4-yr. rotation (oats—clover—timothy—timothy) on a sandy soil,

obtained results indicating that all fertilizers increased the yield but potash was the element which was in the shortest supply in this light sandy soil. The addition of 100 pounds of muriate of potash to 150 pounds of nitrate of soda and 320 pounds of superphosphate once in the rotation nearly doubled the yield. Potash not only increased the yield but also improved the quality of the crops. Without potash, the oat straw broke down, harvest was almost impossible, and the hay crops contained very little clover and many weeds.

At the same station (23), the results of another grain and hay experiment on fertilization, with also a 4-yr. rotation (oats—barley—clover—timothy) on a silt loam this time, have been summarized as follows: It would appear that a mineral fertilizer containing no nitrogen will give as good results as a complete fertilizer and, of course, will cost less. No mention is made if by "good results" one refers to yield or legume content of hay. Highest total yield is not always a good indicator of quality.

One must note that in these Lennoxville experiments no test was made of different rates of potassium fertilizer and no true tall-growing perennial legume like alfalfa or ladino clover was used. Alfalfa is grown with great difficulty in that district and ladino clover is there a rather recent introduction.

At Ste-Anne-de-la-Pocatiere-Station, also, some interesting long-time hay experiments have been conducted on heavy soils as well as on sandy loams, comparing farmyard manure, complete fertilizers, superphosphate, etc. (16). But to our knowledge, no particular study of the specific mineral soil deficiencies regarding tall-growing perennial legumes was published by this station, a study which would necessarily imply a comparison between the different fertilizer elements applied at different rates and frequencies, as it was often done with the fertilizer trials conducted on permanent pastures.

The response of oats and hay to fertilizer elements has been studied at the Central Experimental Farm, Ottawa, both in field experiment and greenhouse tests (19). On Caistor silt loam and North Gower clay loam, where oats in 1946 responded to phosphorus but not to potassium, appreciable increases in hay yields from phosphorus treatments and small increases from potassium were obtained in 1947. On Upland sand and Rubicon sand, where a slight response to phosphorus and to potassium in the oat crop occurred, the hay yields showed a distinct response to each of these elements. Nitrogen treatments which increased the grain yields in all tests resulted in lower hay yields in all tests. From the greenhouse tests it was found from the results obtained in 1947 that in general oats responded to nitrogen and phosphorus but not to potassium, whereas alfalfa yields showed increases from phosphorus and potassium but decreases from nitrogen.

DeLong (1948) from Macdonald College, continuing the work of McKibbin on the most extensive soil type in the Eastern Townships, the Greensboro loam covering about 25% of Stanstead and Compton counties, studied the oat and hay crop responses to lime and fertilizer elements. The use of 10 tons of farmyard manure to an acre, applied broadcast on the oat stubble, was a common and basic treatment to all plots. He found that both phosphorus and potassium, as single fertilizer elements, consistently give statistically significant yield increases. The P K combination, however, is superior to either P or K alone both in respect to increases in yield of hay and in regard to contribution of desirable species to the total yield of this crop. Results obtained under two different 5-yr. rotations provide a clear indication of the importance of potassium in the management of the Greensboro soil, especially in promoting good legume stands in the second-year as well as in the first-year hay crops.

TABLE I.—EFFECTS OF ROTATIONS ON THE YIELD AND THE COMPOSITION OF THE 1945 CLOVER CROP AND ON THE SUPPLY OF EXCHANGEABLE POTASSIUM IN THE SOIL. (DELONG'S DATA)

Treatments	*Rotation 1* Oats for grain—clover—timothy and two crops of mixed grasses			*Rotation 2* Oats for fodder—oats for grain—clover—timothy—mixed grasses		
	Yield of hay. lbs. D.M./plot	Per cent legumes	Exch. K lbs./A.	Yield of hay. lbs. D.M./plot	Per cent legumes	Exch. K lbs./A.
P	18.05	20	105	11.60	3	71
P K	20.15	60	124	18.85	69	91

Table I deserves a close examination. The legumes here included red clover, alsike, and volunteer wild vetch. Knowing the results obtained by Prince and his co-workers (1947) with annual applications of potassium on volunteering, persistence, and yield of red and alsike clovers, and the possibility of maintaining the proper potassium level in the soil with such potassic fertilizer applications, it would be interesting to know if these outstanding differential effects "credited" to the rotations would have been so marked or appreciable to any extent with potassium fertilizer applied lightly and especially at more frequent intervals within the rotation particularly on

Fig. 4. A general view of the eight treatments from the University Farm series. Note the uniform establishment under all treatments. Sown in 1951.

TABLE II.—SHOWING SOME CHARACTERISTICS OF FOUR EXPERIMENTAL SOILS

Name of farm	Organic matter	Mechanical analysis			Soil class	pH		Lime requirement
		Clay	Silt	Sand		1950	1951	
Guenette's (Anc. Lorette)	13.8%	9	26	65	Sandy-loam	5.9	5.5	7,000
Demers' (St-Nicolas)	7.9	16	34	50	Loam to sandy-loam	6.6	6.1	3,800
Roberge's (St-Jean Chrys.)	7.1	8	17	75	Loamy-sand	5.6	5.6	7,650
Laval University (Quebec)	5.8	25	38	37	Clay-loam	5.5	5.5	7,700

the legume hay crops. But this point is probably considered by implication in DeLong's conclusion that the importance of potassium is clearly indicated in the management of the Greensboro soil type.

Experimental Procedures

The results obtained on four Quebec farms will be summarized in this article. These four experimental sites were chosen for their different sets of soil conditions and it was hoped they would represent different levels of available phosphorus and potassium. Table II shows some characteristics of these soils.

On these four different farms, we have tried the same eight treatments which vary in rates of phosphoric acid and potash and are replicated four times on plots 25′ x 10′ in size.

These treatments, annually repeated at the rate of 500 pounds per acre, are as follows:

Symbol of treatment	Treatment formula N — P_2O_5 — K_2O
1 — Check	0 — 0 — 0
2 — P_2K_0	0 — 16 — 0
3 — P_0K_2	0 — 0 — 16
4 — P_2K_1	0 — 16 — 8
5 — P_1K_2	0 — 8 — 16
6 — P_2K_2	0 — 16 — 16
7 — P_2K_2	0 — 24 — 16
8 — P_2K_3	0 — 16 — 24

At the seeding time of these four series of plots, enough sulfate of ammonia was applied to encourage a satisfactory establishment from the nitrogen element standpoint. Liming was also practiced immediately before seeding these plots and the lime incorporated to the soil with the disc, at the rate of about two tons to the acre, except on the University farm series of plots where none was applied. These eight different fertilizer treatments were made at seeding time and mixed with the top inch of soil, or in the early spring of following year as topdressing. These rates of phosphorus and potassium were formed with superphosphate (20% P_2O_5) and muriate of potash (50% K_2O).

The pasture seed-mixture used for all these four series of plots was the same: two pounds of ladino clover, four of red clover, and eight of timothy per acre, along with oats as a nurse crop at the rate of two bushels per acre. On two farms the oat crop was harvested as grain and measured. On the other two, the green fodder was cut and discarded.

The swards were cut, in general, four times a year with a Gravely tractor in the usual manner, trimming off the borders of each plot first, then taking the rest of the plot areas for total green weights and from these, two kilogram-samples were dried for total dry-weight calculations.

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Fig. 1. The corn on the right was fertilized with 80 lbs. N, 60 lbs. K_2O, and 40 lbs. P_2O_5 per acre—yield 75 bushels. The corn on the left was fertilized in the usual manner—yield 30 bushels per acre.

Commercial Fertilizer Is a Sound Investment

By R. A. Wasson

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THE total amount of available plant food used in Louisiana for the past season (September 1, 1951—August 31, 1952) was 40,351 tons of nitrogen, 26,923 tons of phosphoric acid, and 17,907 tons of potassium oxide. While these amounts are not as great as those used in most other Southern States, it is to be considered that we only have some six million acres of cropland including open, plowable pasture. Within the past three years we have increased our use of nitrogen by more than 50 per cent and within the past five years have increased the use of potash by more than 50 per cent.

The estimated annual needs in Louisiana for these available plant foods are 75,000 tons of nitrogen, 50,000 tons of phosphoric acid, and 35,000 tons of potassium oxide.

Thus it is to be seen that we are only at about the halfway mark so far as meeting our fertilizer needs in this State. The potential for increasing production through adequate fertilization, on the land now in use, is very great. In fact, it is the easiest and by far the most profitable way to increase production up to the point where additional plant food does not give a satisfactory return on the investment.

The following discussion is intended to show in some detail what can reasonably be expected from the proper use of fertilizers based upon Experi-

ment Station recommendations. It should be kept in mind that these recommendations are field-proven and profitable. To some they may look excessive but this is not the case. In most cases even greater amounts may be safely used at a good profit to the farmer.

Cotton

Data from the Northeast Louisiana Experiment Station show that on alluvial soils each pound of nitrogen used as a fertilizer for cotton gives an average return of 18 pounds of seed cotton. These data cover a period of 20 years with a rate of application of nitrogen up to 40 pounds per acre.

At the present time, seed cotton has a value of from about 15 cents to 17 cents per pound. At this price the 18 pounds of seed cotton has a value of from $2.20 to $3. Assuming a rate of application of 40 pounds of nitrogen per acre, the dollar and cents value of seed cotton per acre, due to the fertilizer, ranges from $108 to $122.

At current prices, the cost of one pound of nitrogen ranges from about 8 cents to 22 cents, depending on the material used as a source of the nitrogen. An average would probably be around 15 cents. Deduct this probable average cost from the dollar and cents value of the 18 pounds of cotton and it gives an average net return of from $2.55 to $2.91. On the same basis the net return per acre with a 40-pound rate of application of nitrogen runs from $102 to $116.

On soils requiring a complete fertilizer, on the average, one pound of fertilizer gives an increase of about one pound of seed cotton. At present prices one pound of the "complete" fertilizer, recommended for cotton, costs around 3½ cents. By deducting this from the value of the one pound of seed cotton it will give a return of from 11½ cents to 13½ cents for each pound of fertilizer used.

On the same basis and assuming a rate of application of 400 pounds of fertilizer per acre, the net return per acre from the use of fertilizer ranges from $46 to $54 over cost of the fertilizer.

Corn

Data from the Experiment Stations in Louisiana show that on alluvial soils each 2.7 pounds of nitrogen used as a fertilizer gives as a return about one bushel of corn. At present, corn is worth around $1.75 per bushel. On this basis one pound of nitrogen used as a fertilizer on corn gives a net return of about $1.35 over cost of fertilizer. Assuming a rate of application of 120 pounds of nitrogen per acre, the net return per acre is $162 over cost of fertilizer.

On soils where a need for a complete fertilizer with additional nitrogen is indicated for corn, a fertilizer cost of from $15 to $20 per acre shows an average increased return of about 30 bushels of corn which have a value, at present, of around $52.

Sugar Cane

On soils where a need for only nitrogen is indicated by Experiment Station data, the average returns have been about one ton of cane for each 6 pounds of nitrogen used as a fertilizer up to 60 pounds per acre. With $8 as the value of a ton of cane, this gives a return of $2.33 for each pound of nitrogen used. The net return over probable cost of fertilizer is $2.18 for each pound of nitrogen used. Assuming a rate of application of 60 pounds of nitrogen per acre, the net return per acre is about $130 over cost of the fertilizer.

On soils where a need for a complete fertilizer with additional nitrogen is recommended, a fertilizer cost of from $25 to $30 per acre shows a return of from $60 to $80 per acre.

Rice

Fertilizers based on Experiment Station recommendations and costing from $12 to $16 per acre show average returns ranging from $35 to $40 per acre.

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Wisconsin's Soil Bank Balances Are Running Low on Nitrogen and Potash

By C. J. Chapman

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NINETEEN hundred and fifty-two will go down in Wisconsin's history as another great year for hay, corn, grain, and pasture. Our farmers harvested 8½ million tons of hay, 140 million bushels of corn, grain totaling nearly 136 million bushels, and the 4 million acres of pasture averaged at least 1½ tons per acre (dry-matter basis).

In the tabulation below, I have totaled up the plant food taken out of our soils by both feed and cash crops. Based on my calculations it would appear that Wisconsin farmers should be using a million tons a year of a 3½-5-17 fertilizer in order to break even on their soil fertility budget.

Assuming that 40% of the plant food taken up from the soil by feed crops is lost in the feeding transaction and the handling of stable manure and that 50% of the plant food required by special crops and sold for cash is also lost, we arrive at an astounding total of 126,664 tons of nitrogen, 54,281 tons of phosphate (P_2O_5), and 170,768 tons of potash (K_2O). But to offset part of the nitrogen losses we gained 152,024 tons of this element by legume fixation from the air. Bear in mind, however, that this extra nitrogen contained in alfalfa and clover hay or in pea-vine silage is subject to the same 40% loss which we show for non-legumes, in fact, the loss may be even greater by reason of the

1952 Crop Production	Nitrogen		Phosphate as P_2O_5	Potash as K_2O
	From air	From soil		
Alfalfa–brome hay 4,627,000 tons	65,935	43,956	24,870	102,950
Clover–timothy 3,508,000 tons	43,359	28,905	14,032	57,532
All other grass hays (tame and wild) 305,000 tons	.....	3,736	1,220	5,185
Corn 139,954,000 bushels	.....	109,863	39,197	76,974
All grain 135,724,000 bushels	.....	66,000	26,000	64,000
Soybeans 61,000 acres (at 15 bu. per acre)	730	1,700	760	1,980
Pasture (tame and wild) 4 million acres yielding 1½ tons per acre	40,000	50,000	24,000	100,800
Special Crops (350,000 acres)				
Canning peas, canning corn, potatoes, tobacco, sugar and table beets, lima and snap beans, cabbage and onions	2,000	10,000	4,500	14,000
Grand Total	152,024	314,160	134,579	423,421

higher per cent of digestible protein contained in it. So actually our gain amounts to only 60% of the 152,024 tons of nitrogen "fixed" by these legumes. This amounts to 91,214 tons. Subtracting this from 126,664 we arrive at a deficit of 35,450 tons of nitrogen for 1952.

If the above calculations are approximately correct and the net losses of plant food are 35,450 tons of nitrogen, 54,281 tons of phosphate (P_2O_5), and 170,768 tons of potash (K_2O), then I say we are losing plant-food equivalent to a million tons a year of a 3½-5-17 fertilizer. That's a lot of plant food. Actually the tonnage of fertilizer purchased in Wisconsin in 1952, totaling something over 400,000 tons, averaged about 3½% nitrogen, 12% phosphate, 14% potash.

It would appear from these figures that we are using up nitrogen nearly two and one-half times as fast as we're putting it back, not quite breaking even on phosphate, and depleting our supplies of potash at a little over a three to one rate. It's true the fertilizer value of purchased feed shipped into Wisconsin will offset part of these losses, but of course as the tonnage of fertilizer goes up, the tonnage of purchased feed will come down and thus the plant food gained from this source will be reduced. I argue that we need to do more than just break even on our soil fertility losses. We should be paying back part of the debt we owe to our soil bank incurred in the past 75 to 100 years of withdrawals and "going in the red."

What evidence have we to show that it will pay farmers to use fertilizers in anything like the amount that we have shown are needed to break even on our soil fertility budget? First of all, our demonstrations for 1952, backed up with hundreds of similar tests in previous years, have shown that it will pay the average farmer to double the amount of fertilizer he is applying at the time of seeding down. Furthermore, we have shown that it will pay to use more potash in our fertilizer, especially for seedings of legumes.

Average yield data shown in Table I prove without question that potash is especially needed for the legume hay crop. Increases in the yield of hay resulting from treatment with potash are much greater than those shown for the grain crop. Actually it is the hay crop that pays the largest dividend, not only on an investment in potash but on the heavier rates of fertilizer application.

Now what about nitrogen for grain? Yield data shown in Table II tell that story. Actually it was the nitrogen applied to our grain plots that made possible the full utilization of the mineral treatment with phosphate and potash. Where we show a profit of 92 cents per acre over and above cost of fertilizer for

TABLE I.—AVERAGE YIELDS FOR ALL PLOTS WHERE THE CONVENTIONAL (250 LBS.) WAS COMPARED WITH THE DOUBLE RATE (500 LBS.) AND WHERE THE RESIDUAL CARRY-OVER BENEFIT TO THE HAY CROP IN 1949, '50, '51, AND '52 WAS CHECKED; ALSO A COMPARISON OF 0-20-0 WITH 0-20-20.

Treatment	Average[1] yield grain	Average yield straw	Average yield hay	Value of[2] grain, straw, and hay	Cost of fertilizer	Net profit per acre
250# 0–20–0.....	62.8 bu.	2,691#	6,231#	$23.73	$ 6.24	$17.49
500# 0–20–0.....	68.0	2,853	6,940	36.39	10.62	25.77
250# 0–20–20.....	68.9	2,848	7,160	41.14	9.62	31.52
500# 0–20–20.....	68.9	2,875	7,982	51.52	17.37	34.15
No fertilizer.....	50.2	2,033	.....	.....	.....	.....

[1] Includes plots both with and without nitrogen.
[2] Grain figured at 85 cents per bushel—Straw at $8 per ton—Hay at $25 per ton.

Fig. 1. On the Wm. Vickerman farm at Milton, Wis., 500 lbs. per acre of 10-10-10 applied as a topdressing in April increased the yield of pasture forage from 750 to 4,500 lbs. (dry-matter basis). Figuring the value of this extra feed at $50 per ton, this extra 3,750 lbs. was worth $72.75 produced at a cost of $18.50.

minerals only, there was a profit of $7.05 per acre where nitrogen was added. And, of course, it is not fair to charge the full cost of the phosphate-potash treatment against the grain crop. In fact, 350 lbs. per acre are more than we would recommend for grain where no seedings of legumes and grasses are made.

But we have found that some nitro-

Fig. 2. Here on the Clarence Grundahl farm at Evansville, Wis., the yield of corn was increased from 62 to 128 bushels per acre by applying 200 lbs. of ammonium nitrate as a sidedressing. The entire field got 160 lbs. per acre of 4-16-16 starter. The population (stalks per acre) was close to 20,000.

Fig. 3. Two hundred pounds of ammonium nitrate applied as a sidedressing pushed corn yields for Ted Ott, Monticello, Wis., from 74 to 110 bushels per acre. The entire field received 400 lbs. per acre of 4-16-16 as starter. Population (stalks per acre) was 12,232. The photo shows Ted Ott (left) and M. E. Jeglum, County Agent, (right).

gen can be used with profit on a high percentage of our grain acreage in Wisconsin, even where seedings of alfalfa and clover are made, provided such fields are well supplied with minerals. Alfalfa and clover seedlings get off to a stronger start on those plots receiving the double rate treatment with high

Fig. 4. Herman Angerstein and Sons, Milwaukee County, Wis., cooperated with County Agent S. S. Mathisen in a demonstration. The yield of oats was increased from 54 to 95 bushels per acre where 500 lbs. of 0-20-20 plus 100 lbs. of ammonium nitrate were applied. The yield of alfalfa hay in 1952 was increased from 7,068 to 10,790 lbs. on this same plot with a net profit of $56.26 per acre over and above the cost of the fertilizer.

TABLE II.—AVERAGE YIELDS FOR 296 GRAIN PLOTS (MOSTLY OATS)—1945 TO 1952, WHERE A COMPARISON WAS MADE OF 0-20-0, 0-20-20, AND 0-10-30 WITH AND WITHOUT NITROGEN. (AMMONIUM NITRATE APPLIED AS A TOPDRESSING).

Treatment (Average of all plots) (Mostly oats, some barley and wheat)	Yield grain	Yield straw	Value of increase, grain, and straw	Cost of fertilizer	Net profit per acre
350# 0–20–0, 0–20–20, 0–10–30	57.7 bu.	2,518	$10.27	$ 9.35	$ .92
350# 0–20–0, 0–20–20, 0–10–30 plus 100# ammonium nitrate	67.0	3,199	$20.90	13.85	7.05
No fertilizer	47.6	2,096	.....	.....	.....

potash fertilizer. There is less danger of lodging now with the new stiffer strawed varieties of grain and this, likewise, lessens the danger of smothering the seedlings of legumes and grasses where nitrogen is used.

10-10-10 Pasture Results Spectacular

Perhaps most spectacular of all our demonstrations in 1952 have been the results of our 10-10-10 fertilizer trials on pasture where for an average application of 500 lbs. per acre, the total production in terms of dry matter was 6,018 lbs. per acre as compared to 3,176 lbs. for the unfertilized or an increase of 2,842 lbs. Figuring the value of this increase at $50 a ton (actually it is equivalent in feeding value to a 16% or 18% protein dairy feed) we have produced an extra $71 worth of feed at a cost of about $18.50. This leaves a net profit of better than $52 an acre over and above the cost of the fertilizer. And there will be some residual benefit from the phosphate-potash residues showing up the following year, too.

Thousands of Farmers Sidedressed Corn with Extra Nitrogen

Here were the practices which we said last spring were needed to produce 100 bushels or more per acre:

1. Fit the land properly.
2. Use an adapted strain of hybrid seed.
3. Step up stands to 15,000 to 18,000 per acre.
4. Apply plenty of plant food.
5. Control weeds.

The farmers who followed these practices this past year harvested excellent crops of corn. Some 200 farmers joined up with the local county 100-bushel corn clubs, had their soils tested, and followed a prescription or formula. But thousands of others just proceeded on the assumption that plenty of plant food and stepping up the population would turn the trick—and it did.

On fields where no manure was available, there was no clover sod to plow under, the soil was in a rather low state of fertility, and the farmer knew his land wouldn't make better than 40-50 bushels per acre, we made the following recommendations. We said, "Plow under 800 to 1,000 lbs. per acre of an 8-8-8 or 10-10-10, drill or hilldrop seed with a population of 15,000 or 18,000 stalks per acre, apply 300 to 400 lbs. of a starter fertilizer such as 4-16-16, 3-12-12, or 5-20-20. When your corn is knee-high, sidedress with 200 lbs. of ammonium nitrate or other high nitrogen fertilizer to supply the equivalent of from 50 to 60 lbs. of elemental nitrogen." That treatment did pay off with yields of 100 bushels or more.

We set up 50 demonstrations on corn to prove that sidedressing with extra nitrogen would pay. The average increase in yield for 40 comparisons of "With" and "Without" extra nitrogen was 21 bushels. Here then was $30 worth of corn at a cost of $9.

In a few cases increases in yield were amazing. For instance, on the Clarence Grundahl farm at Evansville, the application of 200 lbs. of ammonium nitrate as a sidedressing shot yields from 62 to 128 bushels per acre (22,000 stalks per acre).

Looking Ahead

Based on our 1952 results and backed up by thousands of demonstrations conducted in previous years, I make the following recommendations for 1953:

1. Farmers can profitably apply fertilizer at somewhat heavier rates per acre than are now being used on Wisconsin farms. We are recommending 400 to 500 lbs. per acre at the time of seeding down. On low fertility land in the Spencer Soils area, Professor Emil Truog and others are recommending from 800 to 1,000 lbs. per acre for grain and alfalfa seedings as an initial soil bank investment.

2. Wisconsin soils need potash in increasing amounts for maximum yields of clover and alfalfa. Results in 1952 indicate that benefits from potash show up more on the clover and alfalfa crops the year following its application than on the grain crop the year that seedings are made. We have found that both the 250 and the double rate 500 lbs. per acre treatment with 0-20-20 gave substantial increases in legume hay yields over the 250 and 500-lb. treatments with 0-20-0.

3. The topdressing of old established fields of alfalfa with high potash mixtures, such as 0-10-30 or 0-9-27B, is strongly recommended. Our big crop of hay in 1952 pumped a tremendous amount of plant food out of these fields this past year and if we expect them to make good yields this year it will be necessary to supply additional plant food next spring. Boron deficiencies were widespread last spring, especially in the sandy soils area of central Wisconsin. Topdressing with 0-9-27B (a fertilizer containing 150 to 200 lbs. of fertilizer borate per ton) or with 30 to 40 lbs. per acre of this borate or borax may be found highly profitable.

4. For grain on soils where there is little or no danger of lodging, we are recommending 25 to 30 lbs. per acre of nitrogen. It can be supplied in applications of 400-500 lbs. per acre of 5-20-20 or a 4-16-16 or 100 lbs. of ammonium nitrate, 150 lbs. ammonium sulfate, 215 lbs. nitrate of soda, or cynamid as a supplement to 0-20-20 or 0-10-30. (Treatment with liberal amounts of phosphate-potash fertilizer and the liming of soils up to a pH of 6.5 to 7.0 (slightly acid) is prerequisite to our recommendations of nitrogen for grain where seedings of alfalfa are made.)

5. The lack of nitrogen was the bottleneck that held down yields of corn on thousands of acres in Wisconsin this past year. We are recommending the sidedressing of corn with from 150 to 200 lbs. per acre of ammonium nitrate or its equivalent in other forms of nitrogen fertilizer at the time of the second cultivation, especially on fields where corn follows corn, where corn follows grain, or where timothy or other grass sod is plowed down and where little or no manure is available. Higher rate applications of starter fertilizer should be applied with an attachment on the planter where it is planned to sidedress with nitrogen.

6. Heavy rate applications (800-1,000 lbs. per acre of 10-10-10 or similar mixtures) are recommended for corn on low fertility fields as a substitute for stable manure. This fertilizer should be applied broadcast and plowed under or applied with an attachment on the plow. Additional nitrogen applied as a sidedressing may be found profitable.

7. The topdressing of permanent grass pastures with 10-10-10 or other high nitrogen fertilizer looms up as a great opportunity for low unit cost milk and meat production on Wisconsin farms. I am convinced that there are thousands of acres of pasture land in Wisconsin where the application of 10-10-10 at rates up to 500 lbs. per acre

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The Relation Between Chemical Composition of Herbage and Livestock Production

By M. E. McCullough and W. E. Neville

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THE expanding livestock industry in the Southeast, with its emphasis on grassland products as a source of feed, has intensified the search by agricultural workers for species and varieties of plants suitable to the area. The number of forage plants available for study is so large that a program of elimination is required if those deserving a chance are to be singled out and adequately studied for general recommendation to the livestock farmer. Obviously, it is neither desirable nor economically feasible to study each plant on a large scale basis in which large animals serve as the measuring device. At the same time, past experience has taught both the agronomist and the animal workers the inadvisability of recommending plants that have not been adequately studied under the existing conditions.

At present, the agronomist looks at his plots of forage plants and wonders what their performance would be in terms of meat, milk, or wool. The animal worker looks at the same plot and ponders the question of whether or not he should change from his present forages to some new forage that looks promising from an agronomic point of view but has not been tried in production tests with livestock.

In many instances both groups turn to some general method of analysis hoping to find the answer. The method most frequently used is the one commonly referred to as the "proximate analysis" scheme in which the plant substance is divided into five segments: protein, crude fiber, ether extract, nitrogen-free-extract, and ash.

The "proximate analysis" technique is in such general use that no discussion of the technique itself need be made. From a purely nutritional point of view, however, it might be worthwhile to see what each of the terms is supposed to signify.

Crude protein. As the term implies, this portion of the plant is supposedly composed of the nitrogen-bearing compounds usable by the animal as a source of protein. In general, about 90% of the nitrogen is protein nitrogen. The remaining 10% is in the form of free amino acids, of inorganic salts, and of a number of relatively minor products such as amines, glycosides, chlorophyll, and other nitrogenous compounds. When the forage is being consumed by ruminants this particular term in the analysis is probably adequately descriptive of the nitrogen-supplying ability of the forage.

Crude fiber. When Henneberg and Stohmann first introduced this fraction nearly a century ago, they had as one of their objectives the estimation of the indigestible material of the feedstuff. This was supposedly in contrast with the nitrogen-free-extract fraction intended to represent the carbohydrates which are highly digestible.

In recent years many investigators have expressed considerable doubt

about the use of crude fiber as a measure of the indigestible portion of pasture forages. Armstrong (1), in an extensive study of the change in the lignin and cellulose contents of the dry matter of seven herbage species, found that in alfalfa the crude fiber, at any stage of growth, contains a much higher proportion of lignin than does the crude fiber of grass. He further concluded from his studies—"It therefore follows that to compare, on the basis of crude fiber content, samples of any one species at two stages of growth, is no more legitimate than to compare two distinct species on the same basis."

Crampton (2) reviewed the results of several digestion trials with pasture forages and found that in many cases the crude fiber was the most digestible fraction of the pasture herbage. Comparing the digestibility of the crude fiber and N.F.E. of dry roughages, concentrates, and pasture forages, he found that the crude fiber was as highly digested as the N.F.E. in 39% of the cases with the roughages, 10% with the concentrates, and 67% with the pasture herbage.

Nitrogen-free-extract. In general, this fraction has been given little attention in forage analysis since it merely accounts for substances not included in the other terms. As seen in the discussion of crude fiber, the composition of N.F.E. is of indefinite composition and is of no greater reliability than the crude fiber fraction.

Ether extract. This composes a very small fraction of the dry matter of forages and is generally considered of little importance except for a few substances it (incidentally) includes. Included are the sterols which on exposure to ultraviolet irradiation assume vitamin D activity. Also probably included in this group are members of the carotinoid group, particularly alpha- and beta-carotene which are the precursors of vitamin A.

Ash. The ash content is determined for two reasons: first, to give a measure of the mineral content; and second, in order to compute the N.F.E. The composition of the ash is more important than the quantity, both of which depend upon the species, stage of growth, and soil. Calcium is one of the most variable mineral constituents, being higher in legumes than grasses. Phosphorus, on the other hand, is present in about equal quantities in grass and legumes, and its content in the herbage seems to depend on that present in the soil more than on any other factor.

The above discussion is not intended to discredit the role that the "proximate" analysis of feeding stuffs has played in feeding. It seems, however, that there are definite limits to the nutritional significance which can be placed on the fractions isolated by this procedure when applied to pasture herbage.

Chemical Composition and Animal Performance

In general it is much easier to correlate a change in chemical composition with a corresponding change in the digestibility of a ration than to a definite change in animal response. Thus Swift (6) found that the addition of crude fiber to a balanced ration reduced the total amount of protein and ether extract digested, while the addition of a readily available carbohydrate reduced the digestibility of protein and crude fiber.

Whether or not such a change in digestibility and its resulting change in the quantity of nutrients available to the animal are nutritionally significant depends largely upon the available quantity of each nutrient in relation to the quantity needed by the animal.

The protein content of good forages represents a good example of this situation. Carefully controlled studies have demonstrated that, for dairy cows, rations containing between 12 and 18% protein are most efficient (4) (5). By these standards, average forage fed to

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Fig. 1. Fescue and ladino clover planted late October 1950. Area on left had 800 pounds 6-8-8 fertilizer per acre at planting. Area on right received no fertilizer. Seeding rates and all other treatment were the same. Picture made April 3, 1951. B. W. Norris farm.

People and Grass

By T. D. Alldredge

District Conservationist, Soil Conservation Service, Columbus, Mississippi

PEOPLE working together in Clay County, Mississippi, have formed a partnership with "grass" which is changing the local scenery and attracting national attention.

Five short years ago farmers here were growing about 18,000 acres of cotton. Last year they planted a little over 11,000 acres to this crop. Most of these extra cotton acres, along with a lot of idle acres, have "gone to grass."

In checking with the people of the county we found many reasons for this rapid change from row crops to grass. Some of these reasons are shortage of labor to grow row crops, insect damage, prices received for crops, and adverse weather conditions at planting time. All of these played a part, but it boiled down to two main reasons: (1) A realization by the people that the soils of the county are especially adapted to grassland farming; (2) a getting together of the people to promote grassland farming.

The heavy prairie and lighter coastal plain soils are good producers of grasses and legumes, provided the proper plants are used in the right places along with good management. The climate too is very favorable for grassland farming. Annual rainfall is approximately 54 inches. The average monthly temperature for January is about 45 degrees Fahrenheit, and for July approximately 81 degrees. This combination of soils and climate makes it possible to have the fields covered in green almost the year round.

In 1945 a few farmers started making

soil and water conservation plans on their farms. This meant making the best use of the land and giving it the treatment it needed. Naturally more land was planted to grass. Soon these farms were taking on a better appearance, soil erosion was being slowed down, and the word got around that they were making a little more money.

Other farmers became interested. Soon the banker and other businessmen in town were talking about this new type of farming. Now just about everybody is taking an active part.

The two banks in West Point are making loans to farmers for grassland development and purchase of livestock. These loans are made for a period of years, not like the one-year loans for cotton production. Of course, the farmers must have sound farm plans to obtain this type of loan. Last year the banks gave prizes to the county winners in the Save-Our-Soil contest.

The Soil Conservation District Commissioners, in addition to setting good examples on their own farms in the grassland farming program, own and operate a dragline and bulldozer. This equipment is being used to assist farmers in drainage, where necessary for good land use, and the construction of stock ponds. Approximately eight miles of drainage ditches and 56 stock ponds were constructed on 90 farms last year.

Local civic clubs, Kiwanis, Rotary, and Lions, are helping change the landscape in the county. The clubs joined together and had a field day for farmers and members of the clubs. They visited three farms with this "new look." At each farm the owner explained what he was doing, how he was doing it, and why. The civic clubs furnished the noon-day barbecue.

The West Point Chamber of Commerce is offering $1,500 in prizes this year for pasture development. The slogan for the contest is, "An Improved Pasture on Every Clay County Farm." This contest places emphasis on winter grazing of a permanent type.

Clay County has four well-organized community clubs. These clubs meet once every month. Here they swap ideas and information on the grassland program. Very often they have one of the local agricultural workers meet with them.

Tall fescue is one of many plants being used in the Clay County grassland farming program. It is one of the newer plants here. The story of its rapid expansion serves to illustrate how people working together are making Clay County green.

Joe Strickland in the Pheba community planted 10 acres of tall fescue and white clover on poorly drained, flatwoods land in 1948. He applied two tons ground limestone, 1,000 pounds of basic slag, and 500 pounds of phosphate per acre. One acre of the field had 200 pounds muriate of potash applied in the spring before preparation was started. Joe's pasture turned out so well that not only people from Clay County but people from other counties came to see his pasture and to talk to him about it. Joe has been planting more fescue each year. He always puts down 1,000 pounds of basic slag and 200 pounds potash per acre. Then he topdresses with nitrate as soon as the plants are up.

As a result of Joe's 10 acres of fescue, approximately 500 acres were planted in 1949. Then in 1950 the Clay County Soil Conservation District Commissioners sponsored the 10,000-acre Kentucky 31 Fescue Club. Business people in West Point took an active part and ran a page advertisement in the local newspaper. Membership cards were printed, and information furnished on why, where, and how to grow fescue. The goal was to get 10,000 acres planted by the fall of 1952. It appears that this will be met as approximately 3,500 acres were planted in 1950 and 4,500 in 1951.

H. R. Compton is a farm machinery dealer and a farmer. He says he was first a machinery dealer and started farming a little as a hobby. It was a

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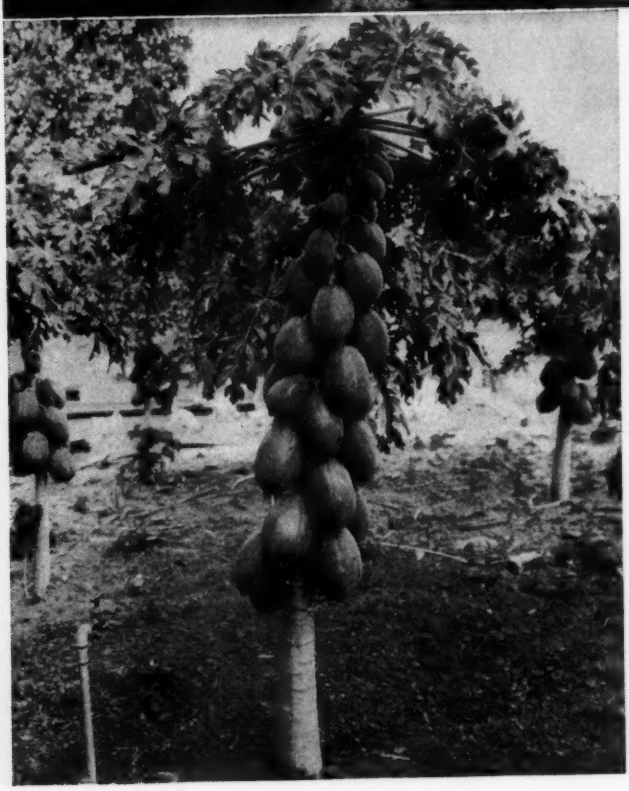
PICTORIAL

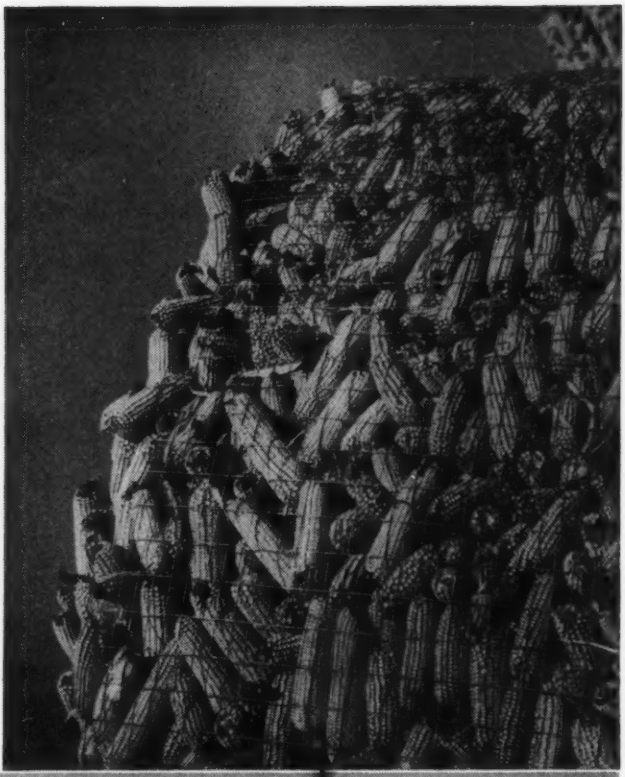
Good samples are important in soil testing.



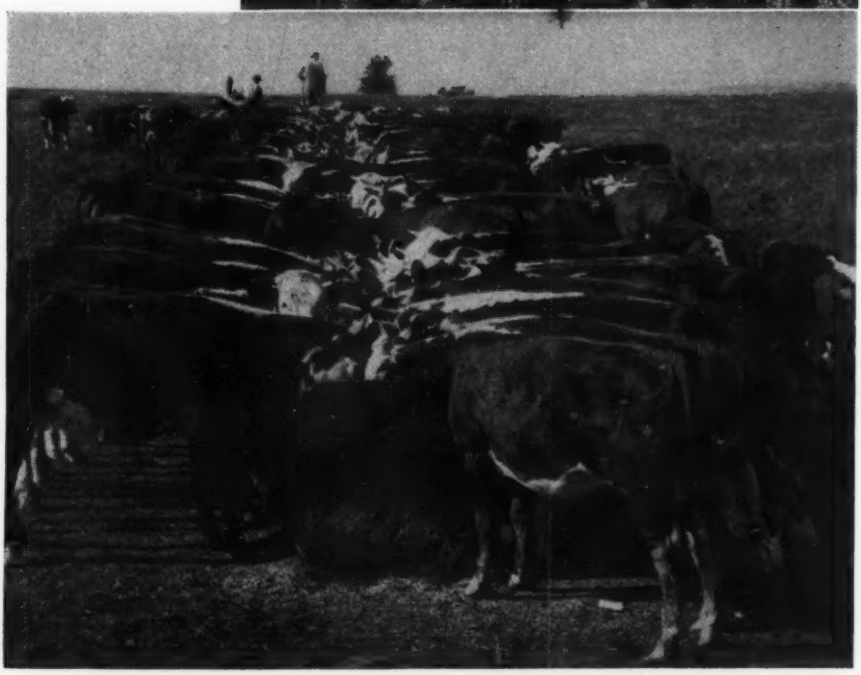
Above: Green vegetables for G. I.'s. U. S. Army Photograph taken in Japan.

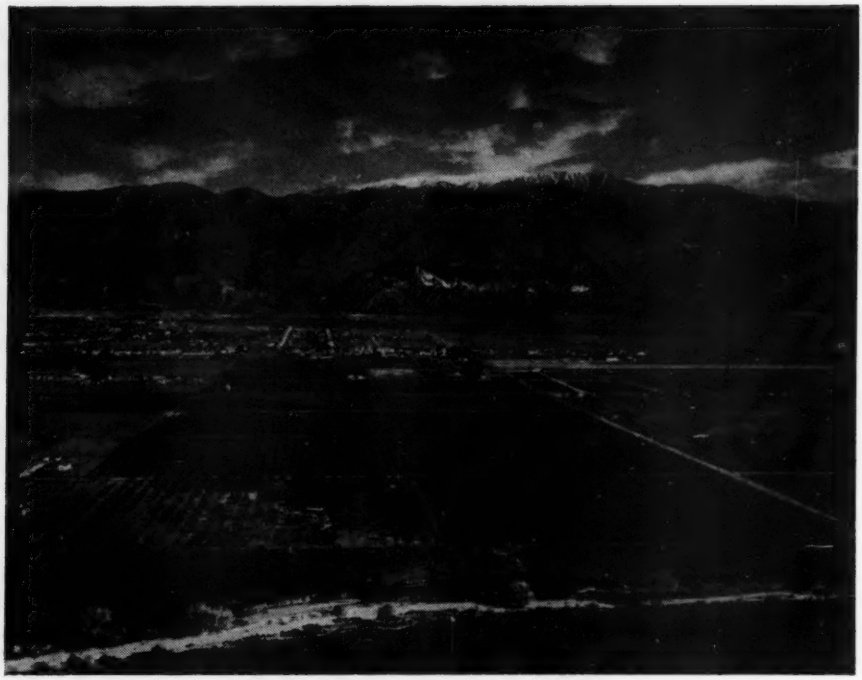
Left: Plenty of good eating on this well-laden papaya plant.

Right: Huge corn crops necessitate many temporary storages.



Below: First come—first served is the rule at these tables.





Above: A peaceful, green California valley.

Below: Most anywhere in the snow country.

The Editors Talk

Our Cover Picture

Green peas, complement of steak, chicken, or most any other meat course on the American dinner table, rank high in favoritism among the vegetable crops. In fact, they rate so high that in acreage devoted to their production they are surpassed only by tomatoes and, in some years, by sweet corn.

It has been said that the pea is the only vegetable that can with certainty be traced back to the Stone Age. Many allusions to its ancient history have been published. Thompson in his book *Vegetable Crops* has this to say, "The garden pea is of very ancient origin and its wild prototype has never been found. The pea was grown by the ancient Romans and Greeks, and some historical writers believe that it was an ancient Egyptian plant. The plant was grown at the time of Cato, 149 B. C. Hedrick et al (1928) state that the ancients did not distinguish carefully between peas, beans, vetches, chick peas, and lentils. This makes it difficult to determine from written accounts what plants were being discussed. From evidence available it seems fairly certain that the pea *Pisum sativum* had its origin in Europe and western Asia. The garden pea was grown in middle and northern Europe in the Dark and Middle Ages. In England it was an important crop in the eleventh century." It is believed that peas were introduced into the United States early in the seventeenth century.

Peas are a cool climate crop. Since they contain relatively large amounts of nitrogen, phosphate, and potash, they should be grown on soils well supplied with these plant-food elements. Although for some time it was thought by some investigators that potash toughened the skin of peas, work at the Geneva Experiment Station in the early 1920's disclosed the contrary—that potash is associated with tenderness and should be adequately supplied to the growing plant.

In the cover illustration against a background field of well-fertilized peas is an inset showing what happens when a plant cannot get enough potash. Such symptoms were well described by Baur and Tremblay of the Western Washington Experiment Station in an article *Potash Pays for Peas at Chehalis, Washington,* appearing in the February 1947 issue of this magazine:

"Potash-deficiency symptoms on peas on the Chehalis soils usually appear most pronounced toward the later part of the growing season. The characteristic symptom is a scorch of the lower leaves. The leaves lose their normally light green color, soon wither and dry, and may in severe cases fall from the plant. These symptoms always appear on the lower leaves first and progress upward from the base of the plant. The growth of the entire plant and its component parts, particularly the leaves, was much less on the potash-deficient plots. While applications of 60 pounds of potash in combination with phosphoric acid have given splendid increases in yield, all of the potash-deficiency symptoms were not eliminated by such applications in 1946.

Although no certain evidence is available, it appears that potash deficiency is more evident and more serious during dry seasons than in years when precipitation is more plentiful."

We are indebted to Dr. J. B. Hester, Soil Technologist, Campbell Soup Co., Riverton, New Jersey, for the kodachromes from which the color plates for the cover illustration were made.

A Look Ahead

A new year beginning, a new administration in Washington, decreasing farm prices, increasing farm costs—no wonder our farmers are looking ahead with a little more than the usual anxiety. Volumes could be written on the published opinions of accredited analysts concerning what lies ahead for agriculture. However, in looking for and briefing the optimistic side, upon which the progress of all American industries has always been built, we find first the concensus expressed by the 30th Annual Agricultural Outlook Conference held in Washington. This in effect is that the over-all picture is good. With an increasing population and a high level of employment, the demand for farm products should result in a gross farm income in 1953 about the same as in 1952.

Gilbert Gusler, Veteran Farm Analyst, opines that net farm income may be off, perhaps by five per cent or more. Still, 1953 will be a year in which the better farmers will be able to save money and add to their net worth.

Mr. Gusler has nine ways to suggest to a farmer for making 1953 a better year than 1952. These, as they appeared in the January 1 issue of Western Farm Life magazine, follow his statement: "Any change in your income in 1953 will depend more on the weather during the growing season and on your effort and management than on any change in economic conditions."

"1—Have a more efficient-sized unit by buying or renting additional land to get the full advantage of mechanization and handling more acres per man.

"2—Grow a larger acreage of high-value crops and boost yields by increased fertilizer use.

"3—Keep only high-producing livestock and feed to obtain good returns per dollar's worth of feed.

"4—Avoid new equipment purchases unless the expenditure is fully warranted by amount of use on your farm or sure opportunities to do custom work.

"5—Have a basic soil fertility and improvement plan and stick to it through good and bad times.

"6—Increase efficiency in use of both hired and family labor by better daily planning to reduce production costs.

"7—Plan production of livestock so as to sell an increased proportion of the output during the high-price periods of the year.

"8—Shop around in making substantial purchases of equipment or supplies.

"9—Be cautious in purchases on credit. Aim to have a lower debt by the end of the year."

We believe this sound advice, the substance of which can be, and undoubtedly is being passed on by agricultural advisers to farmers seeking their advice. While 1953 will present the customary and perhaps some unexpected problems, on this note of optimism, we are hoping that the year continues the succession of good years for American agriculture and in fact proves to be better than 1952.

Season Average Prices Received by Farmers for Specified Commodities *

Crop Year	Cotton Cents per lb. Aug.-July	Tobacco Cents per lb.	Potatoes Cents per bu. July-June	Sweet Potatoes Cents per bu. July-June	Corn Cents per bu. Oct.-Sept.	Wheat Cents per bu. July-June	Hay [1] Dollars per ton July-June	Cottonseed Dollars per ton July-June	Truck Crops ....
Av. Aug. 1909–July 1914....	12.4	10.0	69.7	87.8	64.2	88.4	11.87	22.55	....
1926.....	12.5	17.9	131.4	117.4	74.5	121.7	13.24	22.04	....
1927.....	20.2	20.7	101.9	109.0	85.0	119.0	10.29	34.83	....
1928.....	18.0	20.0	53.2	118.0	84.0	99.8	11.22	34.17	....
1929.....	16.8	18.3	131.6	117.1	79.9	103.6	10.90	30.92	....
1930.....	9.5	12.8	91.2	108.1	59.8	67.1	11.06	22.04	....
1931.....	5.7	8.2	46.0	72.6	32.0	39.0	8.69	8.97	....
1932.....	6.5	10.5	38.0	54.2	31.9	38.2	6.20	10.33	....
1933.....	10.2	13.0	82.4	69.4	52.2	74.4	8.09	12.88	....
1934.....	12.4	21.3	44.6	79.8	81.5	84.8	13.20	33.00	....
1935.....	11.1	18.4	59.3	70.3	65.5	83.2	7.52	30.54	....
1936.....	12.4	23.6	114.2	92.9	104.4	102.5	11.20	33.36	....
1937.....	8.4	20.4	52.9	78.0	51.8	96.2	8.74	19.51	....
1938.....	8.6	19.6	55.7	69.8	48.6	56.2	6.78	21.79	....
1939.....	9.1	15.4	69.7	73.4	56.8	69.1	7.94	21.17	....
1940.....	9.9	16.0	54.1	85.4	61.8	68.2	7.59	21.73	....
1941.....	17.0	26.4	80.8	92.2	75.1	94.4	9.70	47.65	....
1942.....	19.0	36.9	117.0	118.0	91.7	110.0	10.80	45.61	....
1943.....	19.9	40.5	131.0	206.0	112.0	136.0	14.80	52.10	....
1944.....	20.7	42.0	150.0	190.0	109.0	141.0	16.50	52.70	....
1945.....	22.5	36.6	143.0	204.0	127.0	150.0	15.10	51.10	....
1946.....	32.6	38.2	124.0	218.0	156.0	191.0	16.70	72.00	....
1947.....	31.9	38.0	162.0	217.0	216.0	229.0	17.60	85.90	....
1948.....	30.4	48.2	155.0	222.0	129.0	200.0	18.45	67.20	....
1949.....	28.6	45.9	128.0	214.0	124.0	188.0	16.50	43.40	....
1950.....	40.1	51.7	91.7	173.0	153.0	200.0	16.70	86.50	....
1951.....	37.9	51.2	163.0	306.0	168.0	211.0	19.50	69.30	....
1952									
January.....	38.70	46.2	207.0	347.0	168.0	220.0	20.75	70.10	....
February....	37.25	33.8	205.0	357.0	166.0	218.0	20.65	67.10	....
March.....	36.72	23.5	216.0	383.0	165.0	220.0	20.35	61.50	....
April.....	37.30	15.0	231.0	416.0	168.0	218.0	20.05	60.80	....
May.....	36.08	43.5	264.0	433.0	170.0	213.0	18.65	60.80	....
June.....	38.02	44.0	310.0	436.0	173.0	206.0	17.05	61.90	....
July.....	37.02	42.0	274.0	446.0	173.0	198.0	17.25	71.00	....
August.....	37.92	48.8	278.0	410.0	173.0	204.0	19.35	69.80	....
September...	39.11	51.0	222.0	335.0	171.0	209.0	20.25	69.60	....
October.....	36.77	50.9	211.0	294.0	153.0	207.0	20.85	70.70	....
November...	34.05	47.6	217.0	311.0	145.0	213.0	21.25	69.70	....
December....	31.71	49.6	199.0	362.0	150.0	212.0	21.65	68.50	....
Index Numbers (Aug. 1909—July 1914 = 100)									
1926.....	101	179	189	134	116	138	112	98	139
1927.....	163	207	146	124	132	135	87	154	127
1928.....	145	200	76	134	131	113	95	152	154
1929.....	135	183	189	133	124	117	92	137	137
1930.....	77	128	131	123	93	76	93	98	129
1931.....	46	82	66	83	50	44	73	40	115
1932.....	52	105	55	62	50	43	52	46	102
1933.....	82	130	118	79	81	84	68	57	91
1934.....	100	213	64	91	127	96	111	146	95
1935.....	90	184	85	80	102	94	63	135	119
1936.....	100	236	164	106	163	116	94	148	104
1937.....	68	204	76	89	81	109	74	87	110
1938.....	69	196	80	79	76	64	57	97	88
1939.....	73	154	100	84	88	78	67	94	91
1940.....	80	160	78	97	96	77	64	96	111
1941.....	137	264	116	105	117	107	82	211	129
1942.....	153	369	168	134	143	124	91	202	163
1943.....	160	405	188	235	174	154	125	231	245
1944.....	167	420	214	216	170	160	139	234	212
1945.....	181	366	205	232	198	170	127	227	207
1946.....	263	382	178	248	212	209	141	319	182
1947.....	257	380	232	248	336	259	148	381	226
1948.....	245	482	222	253	201	226	155	298	214
1949.....	231	459	184	244	193	213	139	192	201
1950.....	323	517	132	197	238	226	141	384	185
1951.....	306	512	233	349	262	239	164	307	239
1952									
January.....	312	462	297	395	262	249	175	311	337
February....	300	338	294	407	259	247	174	298	217
March.....	296	235	310	436	257	249	171	273	265
April.....	301	150	331	474	262	247	169	270	308
May.....	291	435	379	493	265	240	157	270	285
June.....	307	440	445	497	269	233	144	275	250
July.....	299	420	393	508	269	224	145	315	287
August.....	306	488	399	467	269	231	163	310	229
September...	315	510	319	382	266	236	171	309	182
October.....	297	509	303	335	238	234	176	314	189
November...	275	476	311	354	226	241	179	309	238
December....	256	496	286	412	234	240	182	304	256

Wholesale Prices of Ammoniates

	Nitrate of soda bulk per unit N	Sulphate of ammonia bulk per unit N	Cottonseed meal S. E. Mills per unit N	Fish scrap, dried 11–12% ammonia, 15% bone phosphate, f.o.b. factory bulk per unit N	Tankage 11% ammonia, 15% bone phosphate, f.o.b. Chicago, bulk, per unit N	High grade ground blood, 16–17% ammonia, Chicago, bulk, per unit N
1910–14	$2.68	$2.85	$3.50	$3.53	$3.37	$3.52
1926	3.06	2.41	4.40	4.95	4.36	4.90
1927	3.01	2.26	5.07	5.87	4.32	5.70
1928	2.67	2.30	7.06	6.63	4.92	6.00
1929	2.57	2.04	5.64	5.00	4.61	5.72
1930	2.47	1.81	4.78	4.96	3.79	4.58
1931	2.34	1.46	3.10	3.95	2.11	2.46
1932	1.87	1.04	2.18	2.18	1.21	1.36
1933	1.52	1.12	2.95	2.86	2.06	2.46
1934	1.52	1.20	4.46	3.15	2.67	3.27
1935	1.47	1.15	4.59	3.10	3.06	3.65
1936	1.53	1.23	4.17	3.42	3.58	4.25
1937	1.63	1.32	4.91	4.66	4.04	4.80
1938	1.69	1.38	3.69	3.76	3.15	3.53
1939	1.69	1.35	4.02	4.41	3.87	3.90
1940	1.69	1.36	4.64	4.36	3.33	3.39
1941	1.69	1.41	5.50	5.32	3.76	4.43
1942	1.74	1.41	6.11	5.77	5.04	6.76
1943	1.75	1.42	6.30	5.77	4.86	6.62
1944	1.75	1.42	7.68	5.77	4.86	6.71
1945	1.75	1.42	7.81	5.77	4.86	6.71
1946	1.97	1.44	11.04	7.38	6.60	9.33
1947	2.50	1.60	12.72	10.66	12.63	10.46
1948	2.86	2.03	12.94	10.59	10.84	9.85
1949	3.15	2.29	10.11	13.18	10.73	10.62
1950	3.00	1.95	11.01	11.70	10.21	9.36
1951	3.16	1.97	13.20	10.92	10.18	10.09
1952						
January	3.34	2.07	14.27	11.28	10.39	12.16
February	3.34	2.07	14.27	11.28	11.61	11.08
March	3.34	2.07	14.26	11.28	9.71	9.04
April	3.34	2.07	14.26	11.28	8.80	8.05
May	3.34	2.07	14.25	11.28	7.75	7.36
June	3.34	2.07	14.27	11.28	8.38	8.38
July	3.34	2.07	14.26	11.28	8.19	7.59
August	3.34	2.07	14.26	11.28	9.78	7.89
September	3.34	2.07	13.39	11.25	11.11	10.02
October	3.34	2.07	13.39	11.24	10.62	9.41
November	3.34	2.07	13.31	11.24	10.32	9.71
December	3.34	2.26	13.20	11.24	9.95	9.17
			Index Numbers (1910-14 = 100)			
1926	113	84	126	140	129	139
1927	112	79	145	166	128	162
1928	100	81	202	188	146	170
1929	96	72	161	142	137	162
1930	92	64	137	141	112	130
1931	88	51	89	112	63	70
1932	71	36	62	62	36	39
1933	59	39	84	81	97	71
1934	59	42	127	89	79	93
1935	57	40	131	88	91	104
1936	59	43	119	97	106	131
1937	61	46	140	132	120	122
1938	63	48	105	106	93	100
1939	63	47	115	125	115	111
1940	63	48	133	124	99	96
1941	63	49	157	151	112	126
1942	65	49	175	163	150	192
1943	65	50	180	163	144	189
1944	65	50	219	163	144	191
1945	65	50	223	163	144	191
1946	74	51	315	209	196	265
1947	93	56	363	302	374	297
1948	107	71	370	300	322	280
1949	117	80	289	373	318	302
1950	112	68	315	331	303	266
1951	118	69	377	310	302	287
1952						
January	122	73	408	320	308	345
February	125	73	408	320	344	315
March	125	73	407	320	288	257
April	125	73	407	320	261	229
May	125	73	407	320	230	209
June	125	73	408	320	249	238
July	125	73	407	320	243	216
August	125	73	407	320	290	224
September	125	73	383	319	330	285
October	125	73	383	318	315	267
November	125	73	380	318	306	276
December	125	79	377	318	295	261

Wholesale Prices of Phosphates and Potash **

	Superphosphate, Baltimore, per unit	Florida land pebble, 68% f.o.b. mines, bulk, per ton	Tennessee phosphate rock, 75% f.o.b. mines, bulk, per ton	Muriate of potash bulk, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash in bags, per unit, c.i.f. Atlantic and Gulf ports[2]	Sulphate of potash magnesia, per ton, c.i.f. Atlantic and Gulf ports[2]	Manure salts bulk, per unit, c.i.f. Atlantic and Gulf ports[2]
1910–14	$0.536	$3.61	$4.88	$0.714	$0.953	$24.18	$0.657
1926	.598	3.20	5.57	.596	.854	23.58	.537
1927	.525	3.09	5.50	.646	.924	25.55	.586
1928	.580	3.12	5.50	.669	.957	26.46	.607
1929	.609	3.18	5.50	.672	.962	26.59	.610
1930	.542	3.18	5.50	.681	.973	26.92	.618
1931	.485	3.18	5.50	.681	.973	26.92	.618
1932	.458	3.18	5.50	.681	.963	26.90	.618
1933	.434	3.11	5.50	.662	.864	25.10	.601
1934	.487	3.14	5.67	.486	.751	22.49	.483
1935	.492	3.30	5.69	.415	.684	21.44	.444
1936	.476	1.85	5.50	.464	.708	22.94	.505
1937	.510	1.85	5.50	.508	.757	24.70	.556
1938	.492	1.85	5.50	.523	.774	15.17	.572
1939	.478	1.90	5.50	.521	.751	24.52	.570
1940	.516	1.90	5.50	.517	.730	24.75	.573
1941	.547	1.94	5.64	.522	.780	25.55	.367
1942	.600	2.13	6.29	.522	.810	25.74	.205
1943	.631	2.00	5.93	.522	.786	25.35	.195
1944	.645	2.10	6.10	.522	.777	25.35	.195
1945	.650	2.20	6.23	.522	.777	25.35	.195
1946	.671	2.41	6.50	.508	.769	24.70	.190
1947	.746	3.05	6.60	.432	.706	18.93	.195
1948	.764	4.27	6.60	.397	.681	14.14	.195
1949	.770	3.88	6.22	.397	.703	14.14	.195
1950	.763	3.83	5.47	.371	.716	14.33	.195
1951	.813	3.98	5.47	.401	.780	15.25	.200
1952							
January	.820	3.98	5.47	.420	.827	16.00	.210
February	.820	3.98	5.47	.420	.827	16.00	.210
March	.832	3.98	5.47	.420	.827	16.00	.210
April	.840	3.98	5.47	.420	.827	16.00	.210
May	.860	3.98	5.47	.420	.827	16.00	.210
June	.860	3.98	5.47	.353	.708	13.44	.176
July	.860	3.98	5.47	.386	.768	14.72	.193
August	.860	3.98	5.47	.386	.768	14.72	.193
September	.860	3.98	5.47	.389	.768	14.72	.193
October	.860	3.98	5.47	.391	.768	14.72	.193
November	.860	3.98	5.47	.391	.768	14.72	.193
December	.860	3.98	5.47	.427	.827	16.00	.210
			Index Numbers (1910-14 = 100)				
1926	112	88	114	83	90	98	82
1927	100	86	113	90	97	106	89
1928	108	86	113	94	100	109	92
1929	114	88	113	94	101	110	93
1930	101	88	113	95	102	111	94
1931	90	88	113	95	102	111	94
1932	85	88	113	95	101	111	94
1933	81	86	113	93	91	104	91
1934	91	87	110	68	79	93	74
1935	92	91	117	58	72	89	68
1936	89	51	113	65	74	95	77
1937	95	51	113	71	79	102	85
1938	92	51	113	73	81	104	87
1939	89	53	113	73	79	101	87
1940	96	53	113	72	77	102	87
1941	102	54	110	73	82	106	87
1942	112	59	129	73	85	106	84
1943	117	55	121	73	82	105	83
1944	120	58	125	73	82	105	83
1945	121	61	128	73	82	105	83
1946	125	67	133	71	81	102	82
1947	139	84	135	70	74	78	83
1948	143	118	135	67	72	58	83
1949	144	108	128	67	74	58	83
1950	142	106	112	68	75	59	83
1951	152	110	112	72	82	63	83
1952							
January	153	110	112	75	87	66	85
February	153	110	112	75	87	66	85
March	155	110	112	75	87	66	85
April	157	110	112	75	87	66	85
May	160	110	112	75	87	66	85
June	160	110	112	65	74	56	80
July	160	110	112	70	81	61	82
August	160	110	112	70	81	61	82
September	160	110	112	70	81	61	82
October	160	110	112	70	81	61	82
November	160	110	112	70	81	61	82
December	160	110	112	75	87	66	85

Combined Index Numbers of Prices of Fertilizer Materials, Farm Products and all Commodities

	Farm prices*	Prices paid by farmers for commodities bought*	Wholesale prices of all commodities†	Fertilizer material‡	Chemical ammoniates	Organic ammoniates	Superphosphate	Potash**
1926.....	146	150	146	119	94	135	112	86
1927.....	141	148	139	116	89	150	100	94
1928.....	149	152	141	121	87	177	108	97
1929.....	148	150	139	114	79	146	114	97
1930.....	125	140	126	105	72	131	101	99
1931.....	87	119	107	83	62	83	90	99
1932.....	65	102	95	71	46	48	85	99
1933.....	70	104	96	70	45	71	81	95
1934.....	90	118	109	72	47	90	91	72
1935.....	109	123	117	70	45	97	92	63
1936.....	114	123	118	73	47	107	89	69
1937.....	122	130	126	81	50	129	95	75
1938.....	97	122	115	78	52	101	92	77
1939.....	95	121	112	79	51	119	89	77
1940.....	100	122	115	80	52	114	96	77
1941.....	123	130	127	86	56	130	102	77
1942.....	158	149	144	93	57	161	112	77
1943.....	192	165	151	94	57	160	117	77
1944.....	196	174	152	96	57	174	120	76
1945.....	206	180	154	97	57	175	121	76
1946.....	234	197	177	107	62	240	125	75
1947.....	275	231	222	130	74	362	139	72
1948.....	285	250	241	134	89	314	143	70
1949.....	249	240	226	137	99	319	144	70
1950.....	256	246	236	132	89	314	142	72
1951.....	302	271	263	139	93	331	152	76
1952								
January...	300	275	258	144	98	347	153	78
February..	289	276	255	146	98	365	153	78
March....	288	275	251	144	98	336	155	78
April.....	290	276	251	142	98	322	157	78
May.....	293	276	252	142	98	306	160	78
June.....	292	273	250	141	98	316	160	69
July.....	295	273	250	141	98	313	160	73
August....	295	274	252	144	98	337	160	73
September.	288	271	250	145	98	349	160	74
October...	282	269	248	145	98	341	160	74
November.	277	268	252	144	98	336	160	74
December..	269	267	250	140	101	329	160	79

* U. S. D. A. figures, revised January 1950. Beginning January 1946 farm prices and index numbers of specific farm products revised from a calendar year to a crop-year basis. Truck crops index adjusted to the 1924 level of the all-commodity index.

† Department of Labor index converted to 1910-14 base.

‡ The Index numbers of prices of fertilizer materials are based on original study made by the Department of Agricultural Economics and Farm Management, Cornell University, Ithaca, New York. These indexes are complete since 1897. The series was revised and reweighted as of March 1940 and November 1942.

[1] Beginning July 1949, baled hay prices reduced by $4.75 a ton to be comparable to loose hay prices previously quoted.

[2] All potash salts now quoted F.O.B. mines only; manure salts since June 1941, other carriers since June 1947.

**** The weighted average of prices actually paid for potash is lower than the annual average because since 1926 over 90% of the potash used in agriculture has been contracted for during the discount period. The maximum discount is now 16%. Applied to muriate of potash, a price slightly above $.353 per unit K_2O thus more nearly approximates the annual average than do prices based on arithmetical averages of monthly quotations.**

REVIEWS

This section contains a short review of some of the most practical and important bulletins, and lists all recent publications of the United States Department of Agriculture, the State Experiment Stations, and Canada, relating to Fertilizers, Soils, Crops, and Economics. A file of this department of BETTER CROPS WITH PLANT FOOD would provide a complete index covering all publications from these sources on the particular subjects named.

Fertilizers

"Nitrogen Fertilizers for Corn," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Bul. P114, July 1952, L. Dumenil.

"Phosphate Fertilizers," Agr. Ext. Serv., Iowa State College, Ames, Iowa, Pamp. 184, Apr., 1952, H. B. Cheney and H. R. Meldrom.

"Lime and Its Use," Coop. Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Bul. 314, June 1952, J. A. Porter, P. J. Rood, and E. D. Longnecker.

"Sources of Nitrogen in Crop Production," Agr. Exp. Sta., N. C. State College, Raleigh, N. C., Tech. Bul. 96, Dec. 1952.

"North Carolina Fertilizer Report for 1951-1952," N. C. Dept. of Agr., Raleigh, N. C., Bul. 128, Oct. 1952.

"Adjusting Lime and Fertilizer Recommendations Through Soil Tests for North Carolina," Soil Test. Div., N. C. Dept. of Agr., N. C. State College, Raleigh, N. C., Nov. 1952.

"A Comparison of Blast Furnace Slag and Limestone as a Soil Amendment," Agr. Exp. Sta., Wooster, Ohio, Res. Bul. 708, Nov. 1952, G. W. Volk, R. B. Harding, and C. E. Evans.

"Analysis, Commercial Feeds, Livestock Remedies, Fertilizers, and Agricultural Liming Materials, January-June 1952," Dept. of Agr., Columbus, Ohio.

"Lime for South Carolina Soils," Clemson Agr. College, Clemson, S. C., Cir. 376, Sept. 1952, H. A. Woodle and E. C. Turner.

"Lime, Fertilizer and Manure," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Pub. 336, Sept. 1952, W. Pendergrass.

"Fertilizers Pay," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Leaf. 126, Sept. 1952.

"Fertilizers for Western Washington," Ext. Serv., State College of Wash., Pullman, Wash., Ext. Bull. 386, May 1952, F. T. Tremblay and C. B. Harston.

"The Fertilizer Situation for 1952-1953," PMA, USDA, Wash., D. C., Sept. 1952.

"Fertilizer Resources and Requirements of the United States," Fert. Committee, USDA, Wash., D. C., NSRB 6658, Feb. 1952.

"Bibliography of Literature on the Release and Fixation of Native and Fixed Nonexchangeable Potassium and Ammonium of Soils and Silicate Minerals," USDA, Plant Industry Sta., Beltsville, Md., June 1952, R. F. Reitemeier.

"Cooperative Fertilizer Plants," Farm Credit Admin., USDA, Wash., D. C., Cir. C-145, May 1952, E. G. Grab, W. M. Hurst, and C. L. Scroggs.

Soils

"Agricultural Conservation Program Handbook for 1953 for: Arizona, Montana, National Bulletin USDA, Nevada, New Mexico, North Dakota, Puerto Rico, South Dakota, Tennessee, Utah," USDA, PMA, Wash., D. C., 1953.

"Ontario Soils, Their Use, Management, and Improvement," Ont. Dept. of Agr., Parliament Bldgs., Toronto, Can., Bul. 492, Sept. 1952, L. R. Webber, F. F. Morwick, T. J. Heeg, N. J. Thomas, and N. R. Richards.

"Irrigation and Other Cultural Studies with Cabbage, Sweet Corn, Snap Beans, Onions, Tomatoes and Cucumbers," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 495, June 1952, V. F. Nettles, F. S. Jamison, and F. E. Janes.

"Fertility of Georgia Soils," Exp. Sta., Univ. of Ga. College of Agr., Athens, Ga., Cir. 2, Aug. 1952, J. Giddens and H. F. Perkins.

"Productive Soil," Ext. Serv., Univ. of Ky., Lexington, Ky., Ext. Cir. 468, Rev. Mar. 1952, P. E. Karraker.

"Pave Your Waterways with Grass," Ext. Serv., Mich. State College, East Lansing, Mich., Ext. Fldr. F-171.

"Preliminary Soils Investigation of the Columbus Area, New Mexico," Agr. Exp. Sta., N. M. College of Agr., State College, N. M., Press Bul. 1072, Aug. 1952, D. E. Buchanan.

"Soil and Water Resources, An Appraisal of the Problems and a Statement of Recommendations," Fed. Coop. Ext. Serv., Oreg. State College, Corvallis, Oreg. Agr. 20, Aug. 1952.

"Soil Management in a Young Montmorency Sour Cherry Orchard," Agr. Exp. Sta., Penna. State College, State College, Penna., Bul. 557, Sept. 1952, H. K. Fleming and R. B. Alderfer.

"Farm Ponds," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Pub. 333, Sept. 1951, M. T. Gowder and D. P. Schwab.

"Soil Survey, King County, Wash.," USDA, Wash., D. C., Series 1938, No. 31, Sept. 1952.

Crops

"60th and 61st Annual Reports, January 1, 1949-December 31, 1950," Agr. Exp. Sta., Ala. Polytechnic Inst., Auburn, Ala., June 1952.

"Peanut Production Practices in Southeastern Alabama," Agr. Exp. Sta., Ala. Polytechnic Inst., Auburn, Ala., Cir. 108, June 1952, J. H. Blackstone.

"Rice Breeding and Disease Control Studies in Arkansas, 1940 to 1950," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 525, June 1952, C. R. Adair and E. M. Cralley.

"Origin and Performance of Principal Cotton Varieties in Arkansas," Agr. Exp. Sta., Univ. of Ark., Fayetteville, Ark., Bul. 527, June 1952, J. O. Ware.

"Honeybees and Other Factors in Florida's Legume Program," Agr. Exp. Sta., Univ. of Fla., Gainesville, Fla., Bul. 497, June 1952, G. B. Killinger and J. D. Hayne.

"1950 Annual Report," Agr. Ext. Serv., Univ. of Ga., Athens, Ga., Bul. 567, Jan. 1951.

"Home Garden for the Coastal Plain of Georgia," Ga. Coastal Plain Exp. Sta., Tifton, Ga., Mimeo. Paper 12, Rev. June 1952, O. Woodard and S. A. Harmon.

"Factors Affecting the Growth of Sugar Cane," Agr. Exp. Sta., Univ. of Hawaii, Honolulu, Hawaii, Tech. Bul. 18, Sept. 1952, H. Clements, G. Shigeura, and E. K. Akamine.

"Dahlias for the Amateur," Agr. Ext. Serv., Purdue Univ., Lafayette, Ind., Ext. Bul. 374, 1952, C. E. Hoxsie.

"Growing Rice in the Mississippi Delta," Agr. Ext. Serv., Miss. State College, State College, Miss., Pub. 219 (3M), June 1952.

"Forage Grasses for Hay and Pasture II. Intermediate Wheatgrass Varieties," Cir. 2, May 1952; "Forage Grasses for Hay and Pasture III. Slender Wheatgrasses, Timothies and Other Rapid-Growing Short-Lived Grasses," Cir. 3, July 1952; Agr. Exp. Sta., Univ. of Nev., Reno, Nev., J. M. Robertson.

"Tulips in the Garden," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Cir. 549, Sept. 1952, H. M. Biekart.

"Atlantic Alfalfa," Agr. Exp. Sta., Rutgers Univ., New Brunswick, N. J., Bul. 765, Sept. 1952, W. R. Battle.

"Pumpkins and Squashes in New Jersey," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 9, Aug. 1952, C. H. Nissley.

"Growing Alfalfa in New Jersey," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 94, Sept. 1952, R. A. Briggs.

"Dandelion as a New Jersey Crop," Ext. Serv., Rutgers Univ., New Brunswick, N. J., Leaf. 96, Sept. 1952, C. H. Nissley.

"Grazing Crops for Poultry," Ext. Serv., N. C. State College, Raleigh, N. C., Ext. Fldr. 94, Sept. 1952, C. F. Parrish and S. H. Dobson.

"Cabbage Production Guide," N. C. State College, Raleigh, N. C., Ext. Fldr. 89, May 1952.

"Fall and Winter Pastures," Ext. Div., Okla. A & M College, Stillwater, Okla., Cir. 575.

"Home Lawns for Oregon," Agr. Exp. Sta., Oreg. State College, Corvallis, Oreg., Sta. Bul. 516, H. L. Schudel and H. H. Rampton.

"Establishing the New Lawn," Agr. Ext. Serv., Penna. State College, State College, Penna., Cir. 407, Sept. 1952, A. E. Cooper.

"Mulching Strawberry Plants for Winter Protection," Agr. Exp. Sta., S. D. State College, Brookings, S. D., Bul. 420, May 1952, S. A. McCrory and W. Lazaruk.

"Forage Crop Yields at the Winter Garden Station, 1930-46," Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Misc. Pub. 86, June 23, 1952, E. Mortensen.

"Broomcorn Production in South Texas." Agr. Exp. Sta., Tex. A & M College, College Station, Tex., Progress Rpt. 1468, June 17, 1952, R. A. Hall.

"Abstracts of Recent Research of Factors Influencing Quality of Apples, Juice, and Processed Fruit Products," Agr. Exp. Sta., Va. Polytechnic Inst., Blacksburg, Va., July 1952, L. L. Davis.

"Diseases, Insects, and Other Factors in Relation to Red Clover Failure in West Virginia," Agr. Exp. Sta., Univ. of W. Va., Morgantown, W. Va., Bul. 351T, Apr. 1952, E. S. Elliott.

"Christmas Trees, The Tradition and The Trade," Ext. Serv., USDA, Wash., D. C., Agr. Inf. Bul. 94, 1952, A. M. Sowden.

Economics

"Lemon Management Study," Univ. of Calif., P. O. Box 126, Santa Barbara, Calif., 1951, A. D. Reed, G. E. Goodall, and G. S. B. Ferguson.

"Agricultural Statistics for Ontario, Year 1951," Statistics & Pub. Br., Ont. Dept. of Agr., Parliament Bldgs., Toronto, Can.

"Nineteen Years of Citrus Costs and Returns in Florida, 1931-1950." Agr. Ext. Serv., Univ. of Fla., Gainesville, Fla., AE Series No. 52-3, Mar. 1952, Z. Savage.

"Substitution Relationships, Resource Requirements and Income Variability in the Utilization of Forage Crops," Agr. Exp. Sta., Iowa State College, Ames, Iowa, Res. Bul. 390, Sept. 1952, E. O. Heady and R. O. Olson.

"Farming in Rhode Island," Ext. Serv., Univ. of R. I., Kingston, R. I., Cir. 74, Feb. 1952, G. E. Bond.

"Facts About Dairying in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Cir. 83, Jan. 1952, J. F. Miles.

"The Composition of Farm Income in South Carolina, 1924-50," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Cir. 85, Apr. 1952, W. H. Peterson and G. H. Aull.

"Indexes of Agricultural Production in South Carolina," Agr. Exp. Sta., Clemson Agr. College, Clemson, S. C., Bul. 398, Oct. 1951, C. D. Evans.

"Rates and Dates of Planting Tennessee

Farm and Garden Crops," Agr. Ext. Serv., Univ. of Tenn., Knoxville, Tenn., Pub. 337, Oct. 1952.

"Wisconsin Economic Changes Affecting Farm Fertilizer Use," Wis. Dept. of Agr., Madison, Wis., Spec. Bul. 24, May 1952, C. D. Caparoon and V. C. Struck.

"Economic Use of Forages in Livestock Production on Corn Belt Farms," USDA, Wash., D. C., Cir. 905, July 1952, R. O. Olson and E. O. Heady.

"The Agricultural Research Center of the United States Department of Agriculture," USDA, Wash., D. C., Agr. Handbook 43, June 1952.

"To Keep Your Plate Full," USDA, PMA, Wash., D. C., Sept. 1952.

"Foreign Agricultural Situation," Ofc. Foreign Agr. Relations, USDA, Wash., D. C., Oct. 1952.

"Agricultural Outlook Charts, 1953," Bur. Agr. Economics, USDA, Wash., D. C., Oct. 1952.

"Crops and Markets," Bur. of Agr. Economics, USDA, Wash., D. C., [1952 Edition] Vol. 29.

Phosphate and Potash Effects . . .

(From page 14)

Soil samples were taken in October, from every replication of the eight treatments in 1950 and from only six of them in 1951. The sampling, using an Oliver soil-sampling tube, consisted in taking about 15 "columnettes" from the surface four inches of soil, mixing the whole to make a composite sample for each plot. Available phosphorus and potassium, using Bray's method (4), were determined on each composite sample.

Experimental Results and Discussion

All data gathered on the effects of eight different fertilizer treatments on four ladino swards, and on oat yields have been summarized in Tables III, IV, V, and VI. In Table VIII, the available phosphorus and potassium contents of soil samples taken under the different treatments (the four replications separately) from the four farms have been confronted with their respective herbage yields.

TABLE III.—YIELD OF OATS, PRODUCTION OF SWARDS, AND PERCENTAGE GROUND COVERED BY CLOVERS SOWN IN THE SPRING OF 1950, AS AFFECTED BY THE ANNUAL APPLICATION OF DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON GUENETTE'S FARM

Fertilizer treatment 500 lbs. annually		Percentage ground covered by clovers		Yields of oats—1950 bu./A.	Production of swards—1951	
Treatment symbol	N—P_2O_5—K_2O formula	Fall 1950	Fall 1951		Lbs. D.M. per acre	Check taken as 100
Check	0— 0— 0	17	6	11.35	1,965*	100.0
P_2K_0	0—16— 0	27	5	12.24	2,135	108.7
P_0K_2	0— 0—16	37	39	14.6	3,605	183.5
P_2K_1	0—16— 8	35	30	19.5	3,737	190.2
P_1K_2	0— 8—16	36	54	24.5	4,205	214.0
P_2K_2	0—16—16	45	56	24.7	4,309	219.3
P_3K_2	0—24—16	47	50	27.2	4,657	237.0
P_2K_3	0—16—24	47	65	26.2	4,834	246.0

For the production data of swards, the required "F" values at the 5% and 1% levels are 2.43 and 3.50. The observed "F" value at 5% level (19 to 1 odds) is 25.3. The difference required between treatment means at 5% level is 742 lbs. of dry matter per acre.

TABLE IV.—YIELDS OF OATS, PRODUCTION OF SWARDS, AND PERCENTAGE GROUND COVERED BY CLOVERS SOWN IN THE SPRING OF 1950, AS AFFECTED BY THE ANNUAL APPLICATION OF DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON DEMERS' FARM

Fertilizer treatment 500 lbs. annually		Percentage ground covered by clovers		Yields of oats—1950 bu./A.	Production of swards—1951	
Treatment symbol	N—P_2O_5—K_2O formula	Fall 1950	Fall 1951		Lbs. D.M. per acre	Check taken as 100
Check	0— 0— 0	15	15	15.80	2,791	100.0
P_2K_0	0—16— 0	21	10	23.80	3,000	107.5
P_0K_2	0— 0—16	24	54	26.10	5,082	182.1
P_2K_1	0—16— 8	36	54	27.10	5,386	193.0
P_1K_2	0— 8—16	33	66	30.00	6,092	218.3
P_2K_2	0—16—16	42	65	30.10	6,154	220.5
P_3K_2	0—24—16	42	65	27.75	7,200	258.0
P_2K_3	0—16—24	36	79	25.20	7,256	260.9

For the production data of swards, the required "F" values at the 5% and 1% levels are 2.43 and 3.50. The observed "F" value at 5% level (19 to 1 odds) is 11.6. The difference required between treatment means at 5% level is 1,620 pounds of dry matter per acre. Compared to Guenette series, the Demers experimental site is not so level or uniform.

Significant differences between treatment yields were obtained only with the first two series of plots, these being from Guenette's and Demers' farms.

The soil at the Roberge (St-Jean Chrysostome) experimental site was previously used for a row crop (corn) where heavy applications of farmyard manure were made, leaving this soil in a relatively good state of fertility.

The University series of plots was sown on a clay loam, naturally high in fertility, especially in available potassium (see Table VIII). Our data on its available phosphorus show this soil to be apparently poor in this nutrient. But its pH is still rather low (5.8) and its fixing capacities, being a soil much heavier than the other experimental sites, is presumably higher. It is well

TABLE V.—PRODUCTION OF SWARDS AND PERCENTAGE GROUND COVERED BY CLOVERS SOWN IN THE SPRING OF 1950, AS AFFECTED BY THE ANNUAL APPLICATION OF DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON ROBERGE'S FARM (ST.-JEAN CHRYSOSTOME)

Fertilizer treatment 500 lbs. annually		Percentage ground covered by clovers	Production of swards—1951	
Treatment symbol	N—P_2O_5—K_2O formula	Fall 1950	Lbs. D.M. per acre	Check taken as 100
Check	0— 0— 0	38	5,068	100.0
P_2K_0	0—16— 0	30	5,108	100.8
P_0K_2	0— 0—16	34	5,331	105.2
P_2K_1	0—16— 8	37	5,605	110.6
P_1K_2	0— 8—16	31	6,355	125.4
P_2K_2	0—16—16	34	5,959	117.6
P_3K_2	0—24—16	38	5,970	117.8
P_2K_3	0—16—24	34	5,894	116.3

The "F" test of the treatment mean yields is not significant on this series of plots at the 5% level ($P.<0.05$). The nurse crop has been cut as fodder and discarded.

TABLE VI.—PRODUCTION OF SWARDS AND PERCENTAGE GROUND COVERED BY CLOVERS SOWN IN THE SPRING OF 1950, AS AFFECTED BY THE APPLICATION OF DIFFERENT RATES OF PHOSPHORUS AND POTASSIUM FERTILIZERS ON LAVAL UNIVERSITY FARM, QUEBEC

Fertilizer treatment 500 lbs. annually		Percentage ground covered by clovers	Production of swards—1951	
Treatment symbol	N—P_2O_5—K_2O formula	Fall 1951	Lbs. D.M. per acre	Check taken as 100
Check	0— 0— 0	80	3,046	100.0
P^3K^0	0—16— 0	81	2,880	94.6
P^0K^2	0— 0—16	81	2,889	94.9
P^3K^1	0—16— 8	85	3,419	112.3
P^1K^2	0— 8—16	81	2,911	95.6
P^2K^2	0—16—16	81	3,178	104.4
P^3K^2	0—24—16	84	3,236	106.3
P^2K^3	0—16—24	84	3,038	99.8

The "F" test of the treatment mean yields is not significant at 5% level ($P.<0.05$) on this series of plots. The nurse crop of oats has been cut as fodder and is not included here in the yields which do represent only the two clippings of "grass."

known that liming an acid soil increases the effectiveness or the availability of the soil phosphorus and vice versa for acidifying a neutral soil. On this series there are no significant differences between the percentages of clovers on the different plots or between their herbage yields. But these data are those of the seeding year only and furthermore include only two cuttings of clover. On Demers' and Guenette's farms, there were however broad differences even at the end of their seeding year (Table VIII).

The treatment effects on the ladino swards of both Guenette's and Demers' series of plots have been very similar, from the herbage yield standpoint especially. This similarity of increment in yields due to the different fertilizer treatments over the check plots is evident from a comparison of the last column in Tables III and IV. On both of these soils the nutrient factor limiting the production on the check plots is firstly potassium and that by far above the phosphorus element. Both these soils are poor in available potassium (Table VIII).

If we now look at the increment in yields due to the P^3K^2 and P^2K^3 treatments over the P^2K^2 treatment on both these soils, we think it would have been interesting to have another treatment such as P^3K^3 in these trials. A better idea of the optimum fertilization of these soils for ladino culture would have been gained.

The clover establishment during the seeding year is illustrated also in Tables III, IV, V, and VI. It was normally successful with only the better treatments on Guenette's and Demers' sites, while it was particularly good and uniform on all the plots of the University series and rather erratic on Roberge's soil. In the second year, 1951, on Guenette's and Demers' plots, the percentages of clovers in the swards were in general increasing concurrently with the herbage yields and according to treatments.

In Figures 1-4, some of these striking differences or similarities in the clover proportions can be readily seen.

If we now look at the oat yields given in Tables III and IV for Guenette's and Demers' farms we still find at both places a better response from potash fertilizer than from phosphorus; but on Demers' series of plots, phosphorus appears to be relatively more important

TABLE VII.—RESULTS FROM THE ANALYSIS OF SEVERAL HUNDREDS OF SOIL SAMPLES ANALYZED IN 1950-1951 AT THE PROVINCIAL SOIL LABORATORY, STE-ANNE-DE-LA-POCATIERE, GROUPED INTO THREE CLASSES OF AVAILABLE POTASSIUM AND PHOSPHORIC ACID CONTENTS. THESE DATA ARE GIVEN BY COUNTY AND REGION AND REPRESENT ONLY A PART OF ALL THE ANALYSES DONE ON SAME POINTS. DATA OBTAINED FROM THE PROVINCIAL SOIL LABORATORY

County or region	Number of soil samples	Soil samples grouped according to their K and P_2O_5 content per acre					
		Available K (Morgan's method)			Available P_2O_5 (Bray's method)		
		<50 lbs. per acre poor to very poor	50–100 lbs. fair	>100 lbs. good	<75 lbs. per acre poor to very poor	75–122 lbs. fair	>122 lbs. good
Frontenac	186	147	31	8	157	21	8
Mégantic	58	53	3	2	53	5	0
Beauce #	137	58	69	10	134	2	1
Dorchester	111	77	22	12	110	0	1
Bellechasse	21	19	0	2	19	0	2
Lotbinière–Lévis	47	36	3	8	43	3	1
Drummond	11	8	2	1	11	0	0
Sherbrooke	22	11	6	5	20	1	1
Shefford	5	5	0	0	5	0	0
Brome	7	1	5	1	6	0	1
Missisquoi	21	15	14	2	19	0	2
Compton	21	13	6	2	21	0	0
Nicolet	10	7	1	2	8	0	2
SOUTHEAST—Total	657	450	152	55	606	32	19
Kamouraska–L'Islet	107	48	39	20	76	15	16
Rivière-du-Loup	11	7	2	2	13	1	0
Matane–Matapédia	40	21	14	5	38	0	2
Bonaventure	19	16	3	0	19	0	0
Témiscouata	7	3	4	0	7	0	0
Rimouski	16	3	8	5	16	0	0
NORTHEAST—Total	200	98	70	32	166	16	18
Portneuf	31	24	5	2	30	0	1
Chicoutimi–Roberval	95	29	38	28	62	19	14

Chateauguay–Beauharnois	30	14	1	15	28	2	0
Chambly	96	10	50	36	35	22	39
Grand Total	1,109	625	316	168	927	91	91

#139 other samples from Beauce County have been analyzed with Pilote's method (Sodium acetate pH 4.8), previously used in soil tests, for available potassium. All these samples, except seven which were poor in available potash, were found to be very poor in that soil element. Moreover 80% of them were very poor also in available P_2O_5.

TABLE VIII.—YIELD OF SWARD AND AMOUNTS OF AVAILABLE PHOSPHORUS AND POTASSIUM LEFT IN THE SOIL AFTER THE GROWING SEASON, AS AFFECTED BY THE FERTILIZER TREATMENTS ON FOUR DIFFERENT FARMS

Fertilizer Treatment 500 lbs. annually		Guenette farm					Demers farm					Roberge (St. Jean) farm					University farm [1]		
		Yield of sward lbs./A.	Amounts in lbs./A. of available				Yield of sward lbs./A.	Amounts in lbs./A. of available				Yield of sward lbs./A.	Amounts in lbs./A. of available				Yield of sward lbs./A.	Amounts in lbs./A. of available	
			P		K			P		K			P		K			P	K
Symbol	Formula		1950	1951	1950	1951		1950	1951	1950	1951		1950	1951	1950	1951		1951	1951
Check	0– 0– 0	1,965	87	110	68	64	2,791	35	29	52	66	5,068	116	116	89	73	3,045	55	206
P_2K_0	0–16– 0	2,135	116	171	70	66	3,000	31	47	39	52	5,108	127	140	102	70	2,880	59	186
P_0K_2	0– 0–16	3,605	87	97	109	106	5,082	36	29	61	65	5,331	114	105	166	134	2,889	54	201
P_2K_1	0–16– 8	3,737	109	(2)	97		5,386	31		60		5,605	114		142		3,419		
P_1K_2	0– 8–16	4,205	142		77		6,092	41		52		6,355	129		133		2,911		
P_2K_2	0–16–16	4,309	143	165	127	99	6,154	33	37	54	61	5,959	130	139	154	112	3,178	55	192
P_3K_2	0–24–16	4,657	153	192	113	79	7,200	34	47	70	62	5,970	143	156	169	106	3,236	68	198
P_2K_3	0–16–24	4,834	113	159	120	92	7,256	38	50	80	87	5,894	120	119	154	110	3,038	60	237

[1] This series was sown only in spring 1951.

[2] P_2K_1 and P_1K_2 plots were not analyzed in the fall 1951 for available P and K left in the soil.

to the oat grain crop than to ladino culture, while on Guenette's farm it takes a combination of both elements to produce a considerable increase in grain yield.

From these preliminary results on fertilizing ladino swards with different rates of phosphorus and potassium fertilizers, it can be concluded that some of our soils are really low in available potassium, and some others high; that some of our soils really need, at least for the satisfactory establishment and first seasons of ladino pastures, heavy applications of mineral fertilizer as rich in potash (if not richer) as in phosphoric acid, if applied without farmyard manure; that some fertilizer grades of 0-1-1 ratio such as 0-14-14, 0-16-16, preferably 0-20-20 for topdressing tall legumes and (5-10-10 for the seeding year, without manure) could thus be useful on some of our soils—now that ladino is spreading very rapidly in Quebec and apparently is here to stay.

In our trials, two soils have been found very responsive to generous potash dosage. Whether similar results will be found on a good proportion of our light soils (loam and sand), it remains to be seen by extensive repetition of similar trials, though we know through the improvement of permanent pasture by topdressing with commercial fertilizers that quite a lot of our soils are responsive to a potash application. An important question is then: How much of our light soils will respond remarkably to liberal application of P and K on tall-growing legume stands?

To get a rough idea of the available phosphorus and potassium contents of Quebec soils and their relative poverty in these elements, we have grouped into three classes for both these elements the analyses made on over 1,000 soil samples at the Provincial Soil Laboratory, Ste-Anne-de-la-Pocatiere, and gathered from some 30 counties of the Province. These data will be found in Table VII and they form only a representative part of the analyses made in 1950 and 1951 on the same matter.

From these data, it would appear that quite a lot of our soils are poor to very poor in available potassium as well as in readily soluble phosphorus. This is particularly true for the Quebec counties forming the Eastern-Townships and Beauce regions (i.e., Southeast Quebec) and neighboring the three states of Vermont, New Hampshire, and Maine where generous annual doses of potash and phosphoric acid fertilizers are recommended on ladino stands. It is also in that region that we find the important soil type, the Greensboro loam, where according to DeLong's conclusion (9) the need of potassium is clearly indicated, especially for promoting good legume stands. In Chambly County one finds mostly heavy soils and the soil analyses as a matter of fact reveal quite a different picture; only a relatively small percentage of the soils analyzed appear in the "poor class" of available potassium (Table VII). Of course, it would be necessary to supplement these rapid tests by field tests, but these data are nevertheless indicative of the general level of fertility of quite a lot of our soils. We can presume that some generous (annual, at least for potassium) doses of phosphatic and potassic fertilizers would be necessary in a good proportion of them to get a satisfactory growth and maintenance of our tall-growing forage legumes.

In Table VIII, the levels of available phosphorus and potassium of four experimental soils are given for each treatment on the four farms. At this stage of these trials and with only that small number of soils studied (7, 28) no discussion can be made of the relation between these levels and the yields and quality of ladino swards. With two successive annual applications of 500 pounds of 0-24-16, the soil reserve of available potassium has not been changed apparently on Demers' farm, was raised just slightly on Guenette's series, but still more in Roberge soil.

This might be an indication of the frequent generous doses of potash needed in these two first soils to produce good ladino yields and keep the soil reserve above the optimum limiting growth level.

These preliminary results and those of other experiments conducted in this Province show the great importance of doing similar trials on a wide scale, not only with ladino swards but also on alfalfa stands or on all our tall-growing forage legumes. Frequent failures to establish or maintain alfalfa stands in many districts of Quebec might be partially explained in a parsimonious application of phosphorus and especially of potash, all the other ordinary factors (liming, drainage, etc.) being favorable or having been improved adequately. With systematic use of topdressing fertilizers, one might be able to prolong the life-span of our perennial forage legumes at a high level of quality production and maybe also encourage considerable volunteering of red and alsike clovers (17).

Summary and Preliminary Conclusions

1. In 1950, our fertilizer trials were revised so that the two following points could be studied: (a) Effects of rates of phosphorus and potassium fertilizations on ladino clover swards sown on different soils; (b) the relation between yield and quality of ladino swards with levels of available phosphorus and potassium in the soils. This preliminary report deals with the first objective only.

2. Eight annual fertilizer treatments were tried on four different soils which were sown with similar ladino mixtures in 1950 or 1951. These soils are classed as being a clay loam, a loamy sand, and two others as sandy loams. The treatments were replicated four times on plots 25′ x 10′ in size.

3. Oat yields (on two soils), herbage production, and clover percentages were taken in 1950 and 1951. The available potassium and phosphorus in the soil under the different treatments were analyzed for the four farms.

4. Two soils out of four were found to be very low in available potassium. This element of fertility was in these two cases by far above the available phosphorus as the limiting factor of the establishment and yield of ladino clover stand, and also to some extent of oat grain crop. A fertilizer formula such as 0-16-16 or 0-20-20 used liberally would appear, according to our preliminary results, to form the basis of an optimum fertilization, if no farmyard manure is applied, for the satisfactory establishment and first seasons of ladino swards on some of our soils. On a clay loam soil, rich in available potassium, no response was obtained during the seeding year on the establishment of ladino clover from an application of various rates of potash and phosphoric acid.

5. A good proportion of the thousand soil samples analyzed at the Provincial Soil Laboratory for their available potassium and phosphorus contents were found to be poor or very poor in both these elements, especially those samples gathered in the Appalachian Counties.

6. These preliminary results, added to those of DeLong's obtained on the Greensboro loam and those of the federal experiment stations, show the great importance of conducting similar trials, including rates of phosphorus and potassium, and possibly frequencies of application, on a wide scale, not only with ladino swards but also on alfalfa stands or on any of our tall-growing forage legumes. Such experiments would show the possibility of prolonging the life-span of our hay crops at a high level of quality production, thus reducing the cost of herbage production and of dairy products.

References

1. Ahlgren, H. L. and Burcalow, F. V. (Revised), 1949. Ladino clover. University of Wisconsin. Ext. Serv. Cir. 367, p. 20.

2. Bear, F. E., 1945. Alfalfa—The aristocrat. Better Crops With Plant Food. May, 1945.

3. Blaser, R. E. and Bradly, N. C., 1950. Nutrient competition in plant association. Agronomy Journal 42(3): 128-135.

4. Bray, R. H., 1948. Diagnostic techniques for soils and crops. Chapter 2. Correlation of soil tests with crop response to added fertilizers and with fertilizer requirement. The American Potash Institute, Washington 6, D. C.

5. Brown, B. A., and Munsell, R. I., 1941. Pasture investigation (Ninth Report). Ladino clover experiments, 1930 to 1940. Connecticutt (Storrs) A.E.S. Bul. 235, p. 42.

6. Brown, B. A., 1950. Research on the management of ladino clover. Connecticutt (Storrs) A.E.S. Inf. 8, Jan., p. 3.

7. Chandler, R. F., Peech, M., and Chang, C. W., 1945. The release of exchangeable and non-exchangeable potassium from deficient soils upon cropping. J.A.S. Agron. 37(9): 709-721, 1945.

8. Cornell University, 1949. Fertilizer recommendations for N. Y. field crops, 1950. Dept. of Agronomy. Mimeo. 890, Nov. 13, 1949.

9. DeLong, W. A., 1948. Four P's in progress. Better Crops With Plant Food Magazine, Oct., 1948.

10. Dickey, J. B. R., 1946. Ladino clover. A perennial pasture and hay legume. Penn. State College A.E.S. Cir. 296, p. 10.

11. Donaldson, R. W., 1940. Pasture management. Mass. Extension Service, Ext. Leaf. No. 150. 1940.

12. Hollowell, E. A., 1951. Ladino and other white clovers. Forage. The Science of Grassland Agriculture. Iowa State College Press, Ames, Iowa.

13. Jones, H. E., 1947. Don't feed alfalfa at the second table. Better Crops With Plant Food. April 1947.

14. Lovvorn, R. L. and Dolson, S. H., 1948. Ladino clover pastures for cattle, poultry, hogs. North Carolina A.E.S. (Raleigh) Ext. Cir. (reprint) 301.

15. New Hampshire, 1950. Suggested fertilizers for New Hampshire, 1950. N. H. Extension Service.

16. Pelletier, J. R., 1948. Progress report. 1936-45. Ste-Anne-de-la-Pocatiere Exp. Station, Quebec.

17. Prince, F. S., Blood, P. T., and Percival, G. P., 1947. The response of clover and total forage to topdressing fertilizers. New Hampshire A.E.S. Station Cir. 74, p. 12.

18. Quebec, Ministere de L'Agriculture, 1950. Recommendations du conseil des engrais chimiques de la Province de Quebec pour lannée 1950.

19. Quebec, Ministere de L'Agriculture, 1951. Comité d'enquête des sols. Cinquième réunion annuelle, 17 et 19 avril, 1951. Service de Grande Culture, Division des Sols.

20. Ripley, P. O. et al., 1948. Division of field husbandry, soils and agricultural engineering. Progress report 1936-1948. Central Experimental Farm, Ottawa.

21. Robinson, R. R. and Garber, R. J., 1949. Fertilizer experiments on grasslands in the Northeastern Region. U. S. Regional Pasture Research Laboratory. Penn. State College, Bul. 518, p. 36, Sept., 1949.

22. Smith, L. H., 1949. New hay-pasture crop. Vermont Agr. Ext. Service, Cir. 116, p. 18.

23. Ste-Marie, J. A., et al, 1950. Progress report 1936-1946. Dom. Exp. Station, Lennoxville, Quebec.

24. Stewart, I. and Bear, F. E., 1951. Ladino clover—Its mineral requirements and chemical composition. N. J. Exp. Station, Bul. 759, Oct., 1951.

25. Tysdal, H. M. and Westover, H. L. (revised) 1949. Growing alfalfa. U. S. Dept. Agr. Farmers Bul. No. 1722.

26. Tysdal, T. M., 1951. Alfalfa forage. The Science of Grassland Agriculture. Chap. II: 138-153. Iowa State College Press, Ames, Iowa.

27. Vermont, University of Vermont recommendations for seed, fertilizer, and lime—1951. University of Vermont, Dept. of Agron., Burlington.

28. Winters, Eric, 1945. Crop response to potassium fertilization. Soil. Sci. Soc. of Amer. Proc. 10: 162-167.

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If you think that "old soldiers just fade away," try squeezing into a pair of GI trousers and the blouse you wore in the last war.

Rouge, lipstick, and make-up will make a woman look much younger, but you can't fool a flight of stairs.

People and Grass . . .

(From page 26)

costly hobby while farming row crops, then he got into grassland farming. He now has more investment in his farming than in his machinery business. He planted 25 acres of fescue and white clover last fall, and says, "I will make more profit on that 25 acres this year than I made in all of the five previous years in row crops. I could plow up the grass after this year and still have a profit above the cost of establishing it." However, Mr. Compton does not plan to plow up his grass; he is going to plant more. When asked why the change from row crops to grass, Mr. Compton said, "We have found out this is a grass country and we're working together to put it in grass." While we were talking he patted a new farm tractor he was leaning against, and remarked, "Of course there's a little selfish interest too; the more money there is around, the more of these I'll sell."

Nearly all cars traveling U. S. Highway 45 slow down and a good many stop one mile north of West Point at the B. W. Norris farm. Mr. Norris has 120 acres entirely covered in good green grass and legumes. He has tall fescue and ladino clover, tall fescue and wild winter peas, and rye grass and reseeding crimson clover. One 19-acre field was planted to Kentucky 31 fescue and ladino clover in 1950. Seeding rates were 20 pounds fescue and 3 pounds clover per acre. This planting received 800 pounds 6-8-8 fertilizer per acre at time of seeding and 200 pounds nitrate of soda as topdressing when plants were up to a stand. In 1951 an application of 1,000 pounds 12-10-12 fertilizer was made. Another field of 17 acres received the same treatment but the clover did not come through. However, wild winter peas had been grown in this field and a good volunteer stand of peas has come in each fall.

Many visitors to this farm have asked Mr. Norris how he can afford to use so much fertilizer. His reply is, "I sell feed and I sell fertilizer. I have tried

Fig. 2. This 17-acre field of Kentucky 31 fescue and wild winter peas has been carrying an average of 38 head of cattle since November 1, 1951. Picture made February 6, 1952.

it both ways. I have tried feeding my cattle out of the sack, or putting out fertilizers to grow grass to let them feed themselves. I have found from experience that I can't afford not to use enough fertilizer."

In the last three years 17 farmers from other states who have bought land in Clay County have come to Johnny Moak, Soil Conservation Service technician, and asked for assistance. These men have come from Tennessee, Indiana, Texas, Iowa, Illinois, Wisconsin, Minnesota, and Alabama. All of them have wanted help in planning for grassland farming.

This is the pattern of the old "better mousetrap" story. Clay County, Mississippi, is growing better grass, and a lot of people want to get in on it.

The Relation Between . . .

(From page 24)

dairy cows cannot be considered as deficient in protein. Thus a change in protein content within this range may be reflected in a change in digestibility but not in production. Since rations are usually balanced for a given class of livestock within a range rather than at a fixed point, difference in chemical composition great enough to present a nutritional deficiency may be needed to result in a measurable difference in animal production. This concept of a balanced ration means that in a group of say five cows it is possible to have five different levels of protein (or any other constituent) required to provide the needed protein. Thus a difference of 5% in the protein content of two feeds fed these cows may very well fail to show any difference in their milk production so long as neither cow experienced a protein deficiency.

Crampton (3) conducted feeding trials with non-ruminants (rabbits) to determine the relationship between the fractions isolated from forages by "proximate" analysis and weight gains. He was able to account for 86.3% of the variation in gains by the five fractions isolated. Of the 86.3% of the variations accounted for, some 35.6% were traceable to variations in protein content, 22.6% to ether extract, 22% to ash, 7.1% to crude fiber, and 12.7% to nitrogen-free-extract.

Recent work at this Station has made possible a similar computation for dairy cows (ruminants). In Table I the "proximate" composition, dry matter intake, and 14-day persistency of milk production are listed for 11 different forages. These data were used to compute the correlations and regression shown in Table II. Two points are of particular interest: first, the frequent erroneous conclusions that may be drawn from simple correlations and regressions; and second, the apparent lack of a true significant relationship between the fractions isolated and the production of the cows. Using simple correlations, crude fiber appeared to have a significant effect in reducing the persistency of milk production. When crude fiber was considered in relation to the other fractions (partial regression) rather than from a cause and effect standpoint, its effect was not only reduced but positive in nature.

Although none of the fractions were significantly related to the persistency of milk production (on the basis of partial regression), it is interesting to note that crude protein, crude fiber, and N.F.E. apparently exhibited comparable effects. The data strongly suggest a deficiency of energy (or at least energy as a limiting factor) in the forages under study. The high digestibility of crude fiber frequently found

TABLE I.—CHEMICAL COMPOSITION OF THE FORAGES AND THE CORRECTED PERSISTENCY OF MILK PRODUCTION

Forage	Crude protein	Ether extract	Crude fiber	N.F.E.	Ash	Corrected persistency*	Average daily intake of the forage dry matter**
	%	%	%	%	%	%	lb.
Starr Millet.....	25.47	4.87	22.70	35.80	11.15	100.72	19.6
B. Top Millet...	17.46	4.04	24.46	44.30	9.74	81.12	15.3
Tift Sudan.....	18.94	4.12	25.37	41.27	10.29	73.83	13.7
Bermuda.....	12.58	2.96	29.32	48.48	6.75	68.82	12.6
Dallis.....	15.03	2.59	32.88	42.43	7.07	77.02	14.4
Starr Millet.....	21.03	3.02	27.77	39.16	9.02	71.55	13.2
Fescue.....	11.38	3.92	25.97	50.35	8.38	62.44	11.2
Fescue.....	14.83	3.70	26.39	46.38	8.70	87.96	16.8
Fescue.....	18.84	3.50	23.43	45.43	8.80	104.36	20.4
Fescue.....	21.50	3.84	22.36	43.41	9.00	87.96	16.8
B. Top Millet...	16.58	4.04	22.38	49.76	7.24	112.57	22.2
Average.....	17.60	3.69	25.73	44.24	8.74	84.39	16.0

* 14-day persistency of milk production corrected for forage intake.
** Determined by the use of Chromic Oxide technique.

in such forages probably accounts for this positive relationship.

Finally, it must be admitted that at present we have no single measure which can be applied to a given sample of forage to determine its value in the production of meat, milk, or wool. Great caution should be exercised in predicting the usefulness of a forage plant unless it has been adequately tried in controlled animal experiments.

Literature Cited

1. Armstrong, D. G., H. Cook, and B. Thomas. The Lignin and Cellulose Con-

TABLE II.—CORRELATIONS BETWEEN PERSISTENCY OF MILK PRODUCTION AND FRACTIONS ISOLATED BY "PROXIMATE ANALYSIS"

Proximate principle	Corrected persistency of milk production			
	Simple correlation coef. (r)	Regression coef.	Partial regression coef. (b)	Multiple correlations
Standard analysis:				
Crude protein.....	+.459	+1.78	+2.76	
Ether extract.....	+.424	+10.47	+0.22	
Crude fiber.....	−.637*	−3.09	+1.19	
N-free-extract.....	−.062	−0.22	+2.61	
Ash.....	+.128	+1.54	+0.52	
				$R^2 = .515$
				$R = .718$

* Significant at the 5% level of probability.

Note:

Simple correlation measures the simple relationship of milk persistency to each of the other variables. It does not account for any interaction between fractions.

Partial Regression measures the change in milk persistency to be expected per unit change in a forage fraction with the influence of other fractions eliminated.

Multiple Correlation—the squared R (.515) measures the percentage of the variation in milk persistency accounted for by the five forage fractions.

tents of Certain Grassland Species at Different Stages of Growth. Jour. Agr. Sci. 40; 93-99. 1950.
2. Crampton, E. W. Pasture Studies XIV. The Nutritive Value of Pasture Herbage. Sci. Agr. 19: 345-357. 1939.
3. Crampton, E. W. and R. Forshaw. Pasture Studies XVI. Jour. Nutrition 19: 161-172. 1940.
4. Harrison, E. S. and E. S. Savage. The Effect of Different Planes of Protein Intake Upon Milk Production. Cornell Agr. Exp. Station Bulletin 540. 1932.
5. Harwood, R. E. and G. W. Putman. Hay Versus Low Protein Grain with Pasture. Mich. Quart. Bul. 16: 20. 1933.
6. Swift, R. W., E. J. Thacker, A. Black, J. W. Bratzler, and W. H. James. Digestibility of Rations for Ruminants as Affected by Proportion of Nutrients. Jour. Animal Sci. 6: 432-444. 1947.

Commercial Fertilizer . . .

(From page 16)

Fig. 2. Improved pasture on left was fertilized with 800 lbs. of 6-8-8 per acre plus lime. Native pasture on right was not fertilized. Mississippi Delta soil.

Improved Pastures

1. The average of a 5-year test on thin cut-over pine land in West Louisiana gave 344 pounds of beef per acre due to use of fertilizer and lime.

2. On bluff soils in northeast Louisiana the 5-year average was 226 pounds of beef per acre due to use of fertilizer and lime.

3. On prairie soils of southwest Louisiana the results were 351 pounds of beef per acre due to use of fertilizer and lime.

a. In each case the cost of the fertilizer and lime averaged about $20 per acre per year. The net returns over cost of fertilizer and lime ranged from $36 to $68 per acre.

4. The Livestock and Dairy Station in Washington Parish on its cut-over pine land had a net income from milk of $107.50 per acre on 136 days of winter pasture and $122.86 net per acre on 196 days of summer pasture. It is not known just how much of this net was due to fertilizer and lime, but it would have been at least 75 per cent.

Thus it is to be seen that as an investment, the dividends on proper and adequate fertilization vary from about $2 to $10 for each $1 invested. The safest loan a farmer can make is a fertilizer loan, for there is no other investment on the farm which promises more returns to the farmer or more security for the lender. Present food, feed, and fiber production in Louisiana can be just about doubled if every farmer carried out full research recommendations.

The real farm challenge of the future will be to use every acre to its maximum productive capacity. There's no other way with the ever-increasing demand for food, feed, and fiber. To do this job, plant food is the most essential need. County Agricultural Agents have all the information necessary. Growers should see them about investing wisely in fertilizers and enjoying larger profits from the land they till.

Wisconsin's Soil Bank . . .

(From page 22)

will be found highly profitable. The results of 323 acre-scale 10-10-10 pasture plots carried out in 1951 and 1952 indicate that this is true. The average acre yield calculated as dry matter for all of the 10-10-10 plots harvested was 6,116 lbs. The unfertilized yielded 2,874 lbs., or a gain of 3,242 lbs. This extra forage was equivalent to a 16% or 18% dairy feed which at $50 per ton would amount to $81.05. The cost of 500 lbs. of 10-10-10 last spring was $18.50. Thus, there was an average net profit of $63.55 over and above the cost of the fertilizer for all of the plots where yield data were taken.

Prices for farm produce are high. Fertilizer prices are comparatively low. Farmers have been asked for all out production of meat, milk, and food products. The liberal application of commercial fertilizers in 1953 can be expected to pay off with as great a return per dollar invested as we have ever known.

Farm Budget Bothers . . .

(From page 5)

pass over a certain share of the gross or the net farm income to the beginner. This start in the form of a simple wage, as to a hired man, plus a share of the returns, as with a renter, gives both parties to the deal a working plan that could lead to partnerships and leases—provided the beginner is thrifty and salts down some of his share of the income. Naturally there are also some arrangements made on addition of new stock and equipment, all calling for consultation with authorities who know all the ins and outs of proper farm financing.

We know of several families with numerous children who tried out the well-known father-and-son operating agreements with three or four of the sons in series. Each boy stayed long enough on the home-farm agreement basis to accumulate enough capital and managerial experience to launch his enterprises in a regular lease-and-purchase deal or an outright purchase loan from a bank or a landowner elsewhere. The home farm and the agreement with dad were proving grounds for them to reach for heavier responsibility. Father-and-son deals have had the spotlight for a long time. Many of them have founded real dynasties of competent and successful farmers, one layer upon another. Some of them have turned sour, however, usually on the old human side of things—for which few bankers and farm-management specialists can guarantee a sweet solution.

In the eyes of many wise bankers who know country finance well, it is often hard to tell exactly whether some farm operators suffer from want of suitable, easy-term credit whenever they ask for it; or whether some of their dilemma is due to their own hard luck. That is, a farmer may turn out to be a poor manager or have bad judgment in feeding cattle or choosing rotations and cash crops. This accompanied by price slumps and the ever-present high cost of materials and farm facilities can put him in the doghouse as far as future

sources of long-term credit go. The short-term credit afforded by the cooperative units supervised by the government also have these same things to meet and right now their loans are being examined more carefully than usual under a cautious admonition from the Department of Agriculture.

EVEN the best trained young farmer is open to error in some of his routine operations. A lot of keen old "checker players" in country places who never saw the inside of a college classroom can "hist" their "men" into the king-row along with the most skillful moves, and they possess a rare discernment for both pitfalls and premiums. So we have to face the hard fact that money advanced as ample credit by no means insures the success of a given enterprise. And with the rigorous conditions that farmers face in the realm of hazards and uncertainties due to weather and pest and disease ravages, we conclude that a call for more credit may not be the way to salvation. As a matter of fact, it is probable that farmers as a class have about as wide and deep a reservoir of existing credit at their command as any other occupational segment here. But when it is improperly placed or economic backgrounds turn bad, the clamor is loud enough to obscure the truth.

Loaning capital credit for farms of inadequate size often makes it hard to provide a necessary margin to service the debt and save for the future. This very situation over a period of years accounts for the increase in the size of farms, often made up of smaller units that failed. Too liberal use of credit for beginners can work to their own disadvantage. Aside from the direct burden to them and their need to keep absolutely healthy and alert to meet payments, a broad use of easy and extra ample credit bids up the whole farm field and adds to the capitalization figures that have already become menacing to the industry in some respects.

We have enjoyed but little scientific research on ways and means to make farming a more remunerative occupation in relation to the risk and experience devoted to it. Certainly we have not had this benefit as compared to the advances in the purely productive parts of agriculture. It may be presumed that one reason for this is the variability of human judgment and the almost inflexibility of countless costs and charges laid upon the doorstep of the young farmer from areas where he has not the slightest control. Taxes, insurance, and interest charges, and even the going wages asked by competent farm labor, are often beyond the farmer's control in this complex inter-acting economy. Strikes and walkouts, shifts in materials, and all kinds of outside influences mess up the well-laid plans of the farmer to pay his debts and get square with the world.

A PREDICTED falling-off of the purchase abroad of some of our so-called "surplus" farm commodities can give the specialized wheat, cotton, and tobacco farmer and his like a pretty bad time of it—regardless of how benign and considerate his banker may be or how adept the farmer is in all the arts of husbandry. A sudden curtailment or dislocation of the supplies of steel, copper, aluminum, and other scarce facilities may throw him for another setback in his ambitious plans for progress and production. Verily, the days we were raised in back there were tame and easy times—for the farmer was not commercialized and blueprinted and the farm was not operated on such a tight and intricate schedule.

The tune they play for the 1953 farm business overture sings out that it is not a general drop in average farm prices received that bothers the bucolic planners. On the contrary, the steely eyes of the cautious creditors will be riveted directly on the management skills of the farm debtors as they struggle against production costs already at an all-time high.

Even if the government buoys up slightly sagging farm prices with purchase agreements, loans and subsidies, as well as diversion of the slow-moving surpluses here and there, the main limiting factor to a comfortable margin for the farmer still remains in his operating costs, both seen and unseen, and his own managerial flexibility. As a result, few are looking for a genuine old-style depression, but many are advocating a refresher course in tight-rein management for many young beginners who have never known anything but boom-time conditions.

WE have spoken at some length about the problems that perplex the beginner seeking farm security in his youth. Too few realize that the farm oldster about to get himself a storm cellar in which to retire and watch television is also pondering over what little there is left of the maybe-years ahead. Not long ago the social security people made some house-to-house inquiries among farmers of Wisconsin and Connecticut, asking them, among other things, if they favored adding farm operators to the legal list of self-employed persons to receive retirement benefits. The majority of those with frank opinions said that as things stand the farmer at retirement is not well enough heeled to withstand a long siege against the brutal forces of inflation and rising living expenses.

They believe that the self-employed farmer should be made a regular contributor and beneficiary of the federal social security system, like numerous professions in towns which are already covered. This is said in a purely reportorial way, and not with an eye to influencing legislation. But it shows that agriculture is none too secure at both ends—farms cost too much for beginners and savings are not sufficient for safe retirement.

It is against the grain of all born farm folks to be obliged to measure the success and satisfaction of agriculture with a business slide rule. In a financial way under modern conditions such deliberate niceties and reckonings are essential. They can be carried on without clouding the vision of the farm family to the natural environment that has always meant so much to country dwellers. But he who wants to live on beauty and sentiment amid the scenes and delights of rural life usually has to get completely clear of the commercial and competitive aspects and become a sort of Muir and Thoreau in his own right.

It still remains a fact that the city wage-earner and his folks must carry their financial worries in a murky sphere of smoke and a barren realm of bricks and concrete, while the country family has the location as well as the occupation to fight for—a double reason to exercise the best judgment and the safest precautions in financial planning.

CITY people in recent years have begun to learn the facts of life in regard to the countryman. In earlier days these city families knew the farmers well by comparison. Then a wedge gradually formed and deepened even against the forces of better communication, and the clashes of classes were frequent. Today, we sense a swing backward again to a place where mutual experiences and burdens will be shared and out of it will grow, we trust, a belief that each segment of our society must gain strength and stability if the whole nation is to move in that direction steadily.

Proper financing for the food and fiber producer is not merely a job for some farm lawmaker or managerial expert to uphold and improve. It is deeply rooted and affects us all—maybe not right now so much as in the future. We have a growing population to feed, no more good land to rely upon like the settlers did, and only 15 persons in every 100 engaged in agriculture. Figuring out systems to maintain that minority in a solvent and stabilized economy is a topic pretty close to all of us.

FREE LOAN OF EDUCATIONAL FILMS

The American Potash Institute will be pleased to loan to educational organizations, agricultural advisory groups, responsible farm associations, and members of the fertilizer trade the motion pictures listed below. This service is free except for shipping charges.

FILMS (ALL 16 MM. AND IN COLOR)

The Plant Speaks Thru Deficiency Symptoms (Sound, running time 25 min. on 800-ft. reel.)

The Plant Speaks, Soil Tests Tell Us Why (Sound, running time 10 min. on 400-ft. reel.)

The Plant Speaks Thru Tissue Tests (Sound, running time 14 min. on 400-ft. reel.)

The Plant Speaks Thru Leaf Analysis (Sound, running time 18 min. on 800-ft. reel.)

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Borax From Desert to Farm (Sound, running time 25 min. on 1200-ft. reel.)

Potash Production in America (Sound, running time 25 min. on 800-ft. reel.)

In the Clover (Sound, running time 25 min. on 800-ft. reel.)

In Canada: The Plant Speaks Thru Deficiency Symptoms
The Plant Speaks, Soil Tests Tell Us Why
The Plant Speaks Thru Tissue Tests
The Plant Speaks Thru Leaf Analysis
Borax From Desert to Farm

DISTRIBUTORS

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Southeast: Vocational Film Library, Department of Agricultural Education, North Carolina State College, Raleigh, North Carolina.

Lower Mississippi Valley and Southwest: Bureau of Film Service, Department of Educational Extension, Oklahoma A & M College, Stillwater, Oklahoma.

Midwest: Visual Aid Service, University Extension, University of Illinois, Champaign, Illinois.

West: Department of Visual Education, University of California, Berkeley 4, California.
Department of Visual Education, University of California Extension, 405 Hilgard Ave., Los Angeles 24, California.
Department of Visual Instruction, Oregon State College, Corvallis, Oregon.
Bureau of Visual Teaching, State College of Washington, Pullman, Washington.

Canada: National Film Board, Ottawa, Ontario, Canada.

IMPORTANT

Requests should be made well in advance and should include information as to group before which the film is to be shown, date of exhibition (alternative dates if possible), and period of loan.

Request bookings from your nearest distributor.

AVAILABLE LITERATURE

The following literature on the use of fertilizers in profitable soil and crop management is available for distribution. We shall be glad to send these upon request and in reasonable amounts as long as our supply lasts.

Circulars

Tomatoes (General)
Asparagus (General)
Vine Crops (General)
Better Corn (Midwest)
The Cow and Her Pasture (General)

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F-3-40 When Fertilizing, Consider Plant-food Content of Crops
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Y-5-43 Value & Limitations of Methods of Diagnosing Plant Nutrient Needs
A-1-44 What's in That Fertilizer Bag?
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O-4-50 Birdsfoot Trefoil—A Promising Forage Crop
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K-3-51 Increasing Cotton Yields in North Carolina
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DD-10-51 Fertilizers for Vegetable Crops, Rates, Placement, and Ratios
EE-10-51 Rotation Fertilization
GG-11-51 Fertilizer Recommendations Based on Soil Tests
II-12-51 Pasture Improvement With 10-10-10 Fertilizer
JJ-12-51 Soil Fertility and Pastures
KK-12-51 Potassium in Animal Nutrition
A-1-52 Research Points the Way to Higher Levels of Peanut Production
C-2-52 Potash Needs Move West
D-2-52 Boron for Forage Crops
E-2-52 Ladino Clover—Its Mineral Requirements & Chemical Composition
G-3-52 Alabama's Experience With Alfalfa
H-3-52 The Relative Merits of Inorganic & Organic Sources of Plant Nutrients
J-3-52 Inventorying Soil Improvement
K-3-52 Pastures Pay Profits in Louisiana
L-4-52 Efficient Use of Fertilizer in the Southern Region
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Teacher: "Johnnie, what does f-e-e-t spell?"

Johnny: "I don't know."

Teacher: "Well, I will try to help you. What is it that a cow has four of and I have only two?"

Johnny's answer could have been correct, but he stayed after school just the same.

* * *

The Chief Yeoman, a new man at his heels, stepped up to the big battle wagon's Skipper and saluted smartly.

"Sir," he announced, "I thought the captain would like to know about this new inductee we've just drawn from boot camp. He's Elmer Q. Puddintop, author of the book, 'Our Navy Is Run by Half-Wits.' "

* * *

She wanted to impress the Hollywood magnate with whom she sat at dinner, and remarked, gushingly: "I love Keats."

"Dot's fine," he replied. "I'm always glad to meet a young lady vot lofs children."

* * *

A druggist met an old customer on the street and asked, "Well, Tom, did that mudpack I suggested improve your wife's appearance?"

"It did for a couple of days," replied Tom mournfully, "but then it wore off."

* * *

Doctor: "The pain in your right leg may be due to old age."

Aged Patient: "Rot. Old age, nuthin'. T'other leg, he's the same age and he's all right."

Two men were sitting in a discussion group in an Army camp and the conversation somehow drifted to the topic of reincarnation. A certain private, a firm believer in the subject, was giving his views to the most disliked sergeant in the camp.

"Yes," he said, "when we die we always return as something or someone else."

"Rubbish," snapped the sergeant, "do you mean to say that if I died I might come back as a worm?"

"Not a hope," interjected one of the men, seizing an opportunity. "You're never the same thing twice!"

* * *

The dignified old lady, a pillar of the congregation, shook hands with the pastor after services. "Wonderful sermon!" she exclaimed. "Everything you said applies to somebody or other I know."

* * *

Father: "Well, son, did you kiss your bride?"

Jerk: "No, dad, but I believe she'd let me."

* * *

A complacent golfer teed his ball, looked away to the next green and declared: "That's good for one long drive and a putt."

He swung the driver, tore up the sod, and managed to move the ball a few feet off the tee.

Stepping forward, the diplomatic caddy handed him the putter and suggested, "Now for one hell of a putt."

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* **FERTILIZER BORATE** (*equivalent to approximately 93% borax*) and **FERTILIZER BORATE—HIGH GRADE** (*equivalent to approximately 121% borax*) offer you low-cost, economical sources of boron... in fine mesh for addition to mixed fertilizer, or coarse mesh for direct application where required. County Agents or State Experimental Stations should be consulted for detailed recommendations. Write today for literature and quotations.

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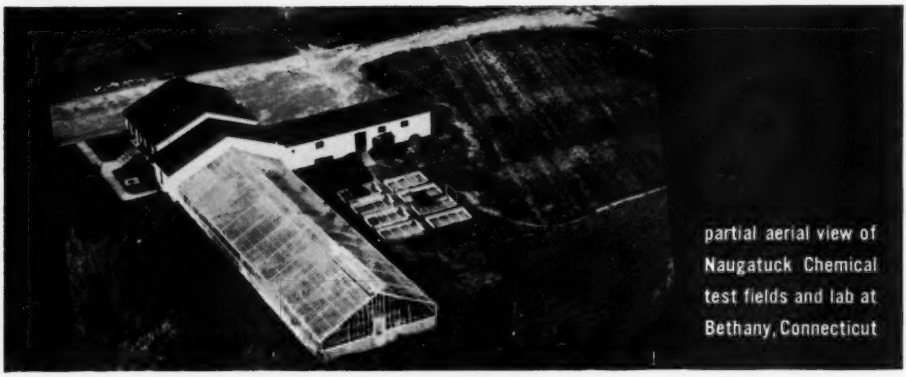

partial aerial view of Naugatuck Chemical test fields and lab at Bethany, Connecticut

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